

COST ACCOUNTING AND COSTING METHODS

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BUSINESS STATISTICS AND STATISTICAL METHOD

By

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Author of "Cost Accounting and Costing Methods"

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COST ACCOUNTING AND COSTING METHODS

inside a factory, and even when they have acquired a good theoretical knowledge of costing, they are handicapped by being unable to see specimens of representative forms and cost accounts. This is a real difficulty, particularly for those studying for the advanced or final examinations, and it is for this reason that many forms and accounts actually in use in various modern factories have been reproduced as illustrations.

A number of examination questions, and entire examination papers set by various examining bodies, have been included by kind permission of the examining bodies concerned.

Many forms and specimen cost accounts which have been used to illustrate the text, and much detail of several of the methods described have been kindly supplied by prominent factory accountants and members of the Institute of Cost and Works Accountants, and to these the author expresses his warmest thanks. In this connection he desires specially to acknowledge the assistance afforded by the following :

C. Baron, F.C.W.A., of the City of Portsmouth Electricity Department, for details of electricity supply costs.

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A. H. Gledhill, J.P., M.I.M.E., F.C.W.A., for permission to reproduce illustrations and data from his "Practical Costing."

International Time Recording Co., Ltd., for illustrations of their instruments and cards.

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principles, for any industry. His function is obviously not to manufacture the goods, but to determine their cost in detail and reveal *where* the methods used produce a gain or a loss.

(The costing scheme should not only find what various jobs or operations have cost, but also what they should cost; it should indicate where losses and waste are occurring before the work is finished, in order that action may be taken, if possible, to avoid or minimise loss and waste there and then.)

The delegation of responsibility, and the division of labour and specialisation, are introduced into industry to secure efficient manufacturing, but every subdivision of effort tends to the possibility of waste, and an important function of management is to exercise such control as will minimise the waste. Adequate costing facilitates this. Business policy may require the consideration of alternative methods or procedure, and this is facilitated by the cost information afforded by the Cost Accountant.

For example, by the aid of cost reports and statistics prepared by the Cost Accountant, the management can decide whether the manufacture of certain products increases overhead expense disproportionately; whether to treat by-products, even if at a loss, to make possible a more important trade in another product; whether the plant and machinery could be used more advantageously by concentrating on particular products to the exclusion of less profitable ones; or whether prices could or should be adjusted.

Costing Essential to Industrial Control.—An efficient system of costing is an essential factor for industrial control under modern conditions of business, and as such may be regarded as an important part in the efforts of any management to secure business stability. The organisation of an undertaking has to be so controlled that the desired volume of production is secured at the least possible cost in relation to the scheduled quantity of the product. Cost Accounting provides the measurement of the degree to which this objective is attained, and thus has a definite place in the organisation of the business. All expense is localised, and thereby controlled, in the light of the information provided by the cost records.

The summary of purposes and advantages of costing detailed on page 5 emphasises the wide range of assistance which costing contributes towards efficient management of complex modern undertakings.

P. H. Lightbody, F.C.W.A., and Gledhill-Brook Time Recorders, Ltd., for supplying many illustrations of time cards.

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A. Williamson, F.C.W.A., Costing Secretary of the British Federation of Master Printers, for the outline of the Federation's uniform system of printers' costs.

A. Wilson, F.I.S.A., and D. A. Palmer, for specimen cost sheets of a cutlery works.

W. R. Wintle, F.C.W.A., for the forms and details of iron foundry costing.

W. Crosskey, F.C.W.A., for Process Cost Sheets, concluding Chap. XVI.

H. J. WHELDON.

August 31, 1932.

PREFACE TO SECOND EDITION

I desire to express my thanks and appreciation to Sir Reginald Townsend, K.C.B., C.B.E., A.C.A., F.C.W.A., President of the Institute of Cost and Works Accountants 1932-1933, for reading through this book and giving many suggestions and ideas for its improvement, which have been incorporated in the present edition. Also to Donald L. Moran, F.C.W.A., President of the Institute of Cost and Works Accountants 1931-1932.

H. J. W.

May 1, 1934.

PREFACE TO THIRD EDITION

The present edition has provided the opportunity of extending the scope of the book to include Municipal Cost Accounting, and in addition to the acknowledgments in the text I desire to thank Mr. W. H. Boddington, B.Com., F.C.W.A., A.I.M.T.A. and Mr. A. W. Muse, F.C.W.A., F.L.A.A., for kindly reading through this additional matter and giving me their valued co-operation. The chapter on Electricity Supply Costs has been re-written and brought up to date. The remainder of the book has been revised and additional matter introduced.

H. J. W.

January 31, 1936.

PREFACE TO FOURTH EDITION

Notwithstanding that but little more than twelve months have elapsed since the publication of the third edition of this treatise, the need for a fourth edition has enabled me to revise the text completely, and to include additional matter where necessary. Numerous requests having reached me for a more elaborate treatment of the matter of Chap. XXIX dealing with the graphic presentation of facts, I may perhaps be permitted to direct readers to my book "Business Statistics and Statistical Method" issued by the publishers of this volume.

H. J. W.

PREFACE TO FIFTH EDITION

The continued approval of this book by Educational Authorities, Teachers and Students is a great encouragement to me to keep it abreast of the latest, established costing practice. In this edition, I have judged it necessary to make minor corrections only.

H. J. W.

September, 1938.

PREFACE TO SIXTH EDITION

The need for a further edition has given me an opportunity to enlarge the treatment of overhead expense, and to effect a number of minor additions and alterations in other chapters.

H. J. W.

August 15, 1940.

PREFACE TO SEVENTH EDITION

The demand for another edition has enabled me to introduce further alterations and additions, some arising from war-time conditions. New examples of Cost Sheets have been introduced. I thank Mr. J. E. Brett, A.S.A.A., and Mr. Wm. M. Johnston, A.C.W.A., for their co-operation in the revision of this edition.

H. J. W.

December, 1941.

PREFACE TO EIGHTH EDITION

In this edition, the third since the outbreak of war, a number of further additions and minor alterations have been made to amplify some of the descriptive matter in Chapters IV, VII, and IX.

H. J. W.

January, 1944.

PREFACE TO NINTH EDITION

During the war years 1939 to 1945 five large printings of this book were called for to meet the incessant demand, but war-time restrictions and difficulties made it impracticable to attempt an extensive revision of the text. In this ninth edition I have revised the text completely, and my publishers have decided to have the book entirely re-set in order to do away with the irritating interpolated pages necessitated by successive partial revisions, and so they have left me free to add much new matter. The book is now completely up-to-date. In addition to the acknowledgments of assistance from eminent practitioners whom I have mentioned in earlier prefaces, I now wish to add the name of Mr. A. J. Tarlton, F.C.W.A., one of my colleagues who has helped me much in the preparation of this edition.

H. J. W.

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Costing in Periods of Trade Depression.—When business is not difficult to secure, many manufacturers are able to show a profit, notwithstanding the leakages which pass unchecked, but in periods of trade depression concealed inefficiencies have to be tracked down, and rigorous control must be exercised to ensure even modest margins of profit.

Failure to maintain normal output in times of acute trade depression results in overhead expenses not being recovered in full. The value of a costing system is even greater at such times, since by indicating where economies may be sought, waste eliminated, and efficiency increased, some of the loss occasioned by reduced turnover and falling prices may be avoided. Further, knowing real costs of production, a manufacturer can fix the lowest possible price on the reduced output when tendering: or, when embarking on a policy of cutting his prices, to increase turnover with the object of avoiding the loss of at least some of those irreducible fixed overheads inseparable from heavy investment in capital assets. Such a policy could not continue for an indefinite period, but may be justified during a trade depression until a revival of business occurs, in that, whilst loss may be suffered, the loss would otherwise be heavier. The policy is, however, a dangerous one, unless operated under the expert guidance of a Cost Accountant, and, in any case, may have harmful repercussions on the industry as a whole, unless judiciously managed. The Cost Accounts provide data for decisions as to how far such a policy may be carried.

✓ **Costing and Governmental Controls.**—Limitation of supplies by Governmental action seriously affects the incidence of overhead expenses, particularly those of a "fixed" nature, and Government restrictions limiting increases in selling prices to actually incurred additional cost demand careful costing, quite apart from the submission of costs necessitated when contracts subject to cost investigation are undertaken.

✓ **Cost Accounting and Price Fixing.**—The preparation of accurate costs of production will guide a manufacturer when deciding upon his price-fixing policy, but in very many instances selling prices are governed only partly by the cost of production—the other influences being the economic law of supply and demand, the activities of competitors, trade associations, fixed price agreements, regulated supply, and the price policy of the management.

✓ **Estimates and Costs.**—Estimates, it should be observed, are


desirable, but over-elaboration must be avoided. The compilation of schedules and analyses with unnecessary details involving undue clerical work will make the system costly, and disproportionate to the benefits received. Still, the costing system should, without exception, cover the whole work of production and services.

4. The records to be made by foremen and workers should involve as little clerical work as possible. Printed forms should be provided, and all instructions written or printed. It is advantageous to provide written or printed instructions as to the origin, use, and disposition of each form.

5. To ensure reliable statistics, every original entry on factory forms should be supported by an examiner's signature, or counter-checks.

6. Promptitude, frequency, and regularity in the presentation of costs and statistics must be arranged for.

7. The Cost Accounts and Financial Accounts should be either interlocked in one integral accounting scheme, or so arranged that the results shown by the two sets of accounts can be reconciled, as for instance by the use of Control Accounts or a Cost Control Total Account or Schedule.

 **Summary of Purposes of Cost Accounts and Statistics.**—The following summary may be useful to the student:—

1. The expenditure recorded and summarised in the Financial Accounts is analysed and classified with reference to the cost of products and operations.

2. To arrive at the cost of production of every unit, job, operation, process, department or service, and develop cost standards.

3. To indicate to the management any inefficiencies, and the extent of various forms of waste, whether of materials, time, expense, or in use of machinery, equipment, and tools. Analysis of the causes of unsatisfactory facts may indicate remedial action.

4. To provide data for periodical Profit and Loss Accounts and Balance Sheets at such intervals, *e.g.* weekly, monthly, or quarterly, as may be desired during the financial year, not only for the whole business, but also by departments or individual products.

5. To reveal sources of economies in production, having regard to methods, types of equipment, design, output, and

3. What are the main features in presentation of costing data? Assuming it is your duty to write a monthly report on a factory where process costing is in use, what features would you expect to discuss? Indicate briefly the form of your report.—*Institute of Cost and Works Accountants (Final)*.

4. A small manufacturing business, until recently conducted by the proprietor, has now been taken over by a Company of which the late proprietor is Managing Director. A considerable amount of new capital has been brought into the business to finance extensions. The late proprietor has conducted the business successfully for many years, he is an expert in the trade, and felt no need of costing records.

Assume the products to be of any kind with the manufacture of which you are familiar, and write a report for the new Board, giving reasons for the introduction of a Costing system and outlining a suitable system.—*London Chamber of Commerce*.

5. What advantages would you expect to accrue from the institution of a uniform system of costing throughout an industry?—*London Chamber of Commerce*.

6. What objects are to be obtained from the keeping of Cost Accounts that cannot be obtained from the usual Financial Accounts?—*Royal Society of Arts (Advanced)*.

7. What is meant by Standard Costs; in what circumstances may they safely be employed; what advantages do they offer?—*Institute of Cost and Works Accountants (Inter.)*.

8. Show that Cost Accounting is essential to industrial efficiency.—*Institute of Cost and Works Accountants (Inter.)*.

9. What is meant by the expression "predetermined Costs"? For what purposes are they used?—*Institute of Cost and Works Accountants (Inter.)*.

10. Give five examples of the manner in which Cost Accounting aids management.—*Institute of Cost and Works Accountants (Inter.)*.

11. Write a short essay on the uses of Costing in periods of industrial depression and explain how the information supplied by the Cost Accountant is best utilised.—*Institute of Cost and Works Accountants (Final)*.

12. What advantages would you claim for a scheme of Budgetary Control and what safeguards would you suggest in connection with its use?—*Institute of Cost and Works Accountants (Final)*.

13. Do you consider there is any necessity for keeping Cost Accounts in a monopolistic industry? State your reason in full.—*Institute of Cost and Works Accountants (Final)*.

14. Distinguish between (a) estimates, (b) costs, (c) prices, and indicate how they are related to each other.—*Institute of Cost and Works Accountants (Final)*.

15. Write a short treatise of about 300-400 words on the modern trend of Cost Accounting.—*Institute of Cost and Works Accountants (Final)*.

16. What are the primary and secondary objects of scientific costing? What other purposes can it be made to serve?—*Institute of Cost and Works Accountants (Final)*.

17. What effect would a good system of Costing have on management?—*Institute of Cost and Works Accountants (Final)*.

18. You are consulted by a manufacturing concern to advise them as to installing a system of Costing. Write out a report to the board of directors detailing the general lines of your investigation, setting out the advantages to be gained by the adoption of such a system and indicating the directions in which its cost would be recovered.—*Institute of Cost and Works Accountants (Final)*.

19. Explain why Cost Accounts are said to be the key to economy in manufacture.—*Society of Incorporated Accountants and Auditors (Inter.)*.

20. It is contended that competition governs prices and that where

10 COST ACCOUNTING AND COSTING METHODS

production efficiency is good there is no need for a proper system of Costing. What arguments would you advance to elucidate this opinion?—*Institute of Cost and Works Accountants (Final)*.

21. Explain fully the advantages to a manufacturer or contractor of keeping Cost Accounts, and contrast the advantages with any possible disadvantages.—*Society of Incorporated Accountants and Auditors (Inter.)*.

22. State briefly the advantages of Cost Accounts.—*Chartered Accountants (Inter.)*.

23. State briefly the essential requirements of a costing system for a manufacturing business.—*Chartered Accountants (Inter.)*.

§ 12 m

CHAPTER II

THE ELEMENTS OF COST AND THE METHODS OF COSTING

✓ **The Analysis and Classification of Cost.**—It is necessary to analyse and classify manufacturing costs if management is to be provided with the data required for cost control.

A classification has to be made to arrive at the detailed costs of departments, processes, production orders, jobs, or other cost units. The total cost of production can be found without such analysis, and in many instances an average unit cost could be obtained, but none of the advantages of an analysed cost would be available.

Generally speaking, all expenditure may be divided into groups corresponding to the activities of a manufacturing concern, namely :

(a) Producing Departments or Shops.	} Expenditure of Manufacturing.	} Cost of Sales.
(b) Service Departments.		
(c) Works Expenses.		
(d) Administration Expenses.		
(e) Selling Expenses.		
(f) Distribution Expenses.		

Again, total cost can be separated under three broad headings—namely, Materials, Labour, and Expense—and these three groups of expenditure are known as the elements of cost.

THE ANALYSIS OF TOTAL COST

The total expenditure incidental to production, administration, selling, and distribution is analysed by the cost accountant according to the elements of cost. The elements of cost are :

(i) Direct Labour.	} Prime Cost.	} Works or Factory Cost.	} Total Cost of Sales.
(ii) Direct Materials.			
(iii) Direct Expenses.			
(iv) Overhead Expenses—comprising (a) Departmental, (b) General, (c) Services, and (d) Administration.			
(e) Selling, (f) Distribution.			

- (iv) Material passing from one operation or process to another, *e.g.* produced, converted, or part-manufactured material which is intended for further treatment or operations.
- (v) Primary packing materials (*e.g.* cartons, wrappings, cardboard boxes, etc.).

The following descriptions are used in the same sense as Direct Materials: Process Material; Prime Cost Material; Production Material; Stores Material; Constructional Material.

Items such as import duties, dock charges, transport of materials, storing of materials, cost of purchasing and receiving materials, cost of rectifying materials, are proper additions to their invoiced price, and when this course is followed the materials are charged out at this augmented initial cost. As to Indirect Material see page 16.

Raw Material.—Reference may be usefully made here to the term "Raw Material." In the majority of instances the finished product of one industry is the raw material of another. Thus sheet steel may be the finished product of the steel rolling-mill, but the raw material of a metal-cutting works. The finished product of a wool-spinning mill becomes the raw material of the weaving-mill. Pulp board is the finished product of mills which pulp timber, but this is part of the raw material of the paper-mill.

Circumstances arise when some direct materials are used in comparatively small quantities, and it would be a futile elaboration to make an analysis of them for the purpose of a direct charge. In the manufacture of hats or sewn boots it would be absurd to measure the value of the thread; or in making cardboard boxes, to determine the glue cost for fixing strips of linen used for binding the corners. Such direct material as this should be treated as a production expense item.

Direct Expenses.—This includes any expenditure other than direct material or direct labour directly incurred on a specific cost unit. Such special necessary expense is charged directly to the particular cost account concerned, as part of the prime cost.

This item is sometimes termed "Chargeable Expenses."

Examples of direct expenses—

- (a) Hire of special or single purpose tools or equipment for a particular production order or product.
- (b) Costs of special layout, designs, or drawings.
- (c) Maintenance costs of such equipment.

The distinction between Direct Expense and Direct Departmental Expense should be observed :

When expenses can be allocated directly to a particular department, as, for instance, such items as power, light, and heat, indirect labour, rent, rates, water, gas, etc., they are described as Direct Departmental Expenses, but they are Indirect Expenses so far as the allocation to particular cost units is concerned.

Overhead Expenses.—The three elements of cost just described constitute Prime Cost, and all expense over and above Prime Cost is Overhead, or, as it is frequently termed, "Oncost"—an unfortunate misnomer. Prime Cost plus all Works Overhead represents Works, or Factory, Cost. Works Cost plus all other Overheads represents Total Cost.

"Overhead" may be defined as the cost of indirect material, indirect labour, and such other expenses, including Services, as cannot conveniently be charged direct to specific cost units. Alternatively, overheads are all expenses other than Direct Expenses.

In general terms Overhead comprises all expenses incurred for or in connection with the general organisation of the whole or part of the undertaking. In other words the general costs of operating supplies and services used by the undertaking, and including the maintenance of capital assets.

The main groups into which Overhead may be sub-divided are :

- (a) Production or Factory Expense, including Services ; often called Works Oncost.
- (b) Administration Expense, regarded as part of the manufacturing costs.
- (c) Selling Expense.
- (d) Distribution Expense. } Sometimes combined.

All items of Overhead are dissected and collected under these four headings, and are subsequently distributed in some suitable manner as described in Chapter XI, which ensures their fair allocation to Departments or Centres for recovery upon each individual cost unit by means of expense rates as described in Chapter XII.

Overhead may also be classified as Fixed Overhead and Variable or Floating Overhead, and this aspect of expense analysis is discussed on pages 117 and 118.

This element of cost has a number of synonyms, such as

Oncost, Establishment Charge, Burden, General Expense, Indirect Expense, and On-Charges.

Oncost is a term very frequently used for Overhead, but it is desirable that it should be discontinued, for the reason that Overhead is as much *part of the cost* as direct labour and prime cost materials, hence such expense is wrongly described as Oncost. In this book the term Overhead or Expense is used instead of Oncost.

THE SUB-DIVISIONS OF OVERHEAD EXPENSES

Production (or Factory) Expense is all indirect expenditure incurred by the undertaking from the receipt of the order until its completion ready for dispatch, either to the customer or to Finished Goods Store. Any expenses not taken to account as a Direct Expense are known as "Overheads."

Other terms used are : Factory Overhead ; Factory Oncost ; Works Overhead ; Works Oncost ; Mill Oncost.

Examples of Production Expense, *i.e.* Works Overhead, are :

- (a) Rent, rates, insurance, chargeable against the works, excluding any which can be apportioned to the general administration offices, selling departments, warehouse, and distribution.
- (b) Indirect labour, *e.g.* supervision, such as salary of works managers, wages of foremen, etc. ; shop clerical work ; testing, gauging, and examining ; indirect labour in connection with production shops (see page 16).
- (c) Power (steam, gas, electric, hydraulic, compressed air) and other services in aid of production ; process fuel ; internal transport ; canteens, etc. (see page 125).
- (d) Consumable stores, and all forms of indirect material, *i.e.* material which cannot be traced as part of the finished product, such as cotton waste, grease and oil, small tools, etc. (see below).
- (e) Depreciation, maintenance, and repairs of buildings, plant, machinery, tools, etc.
- (f) Sundry expenses *re* personnel, such as employment office, works police, rewards for suggestions and all forms of welfare such as canteens, recreation, first aid, works entertainments, works newspapers, radio music, and safety first.

It is part of the total Factory Cost. It is sometimes called Office Oncost, but this description is rather too limited for the modern conception of administrative expenses.

Examples are : The expenses in running the general offices, *e.g.* office rent, light, heat, salaries and wages of clerks, secretaries, accountants, credit approval, cash collection and treasurer's department, general managers, directors, executives ; legal and accounting machine services ; investigations and experiments ; and miscellaneous fixed charges.

✓ **Selling Expense.**—This portion of the Overhead comprises the cost to producers or distributors of soliciting and securing orders for the articles or commodities dealt in, and of efforts to find and retain customers. It includes advertising ; salaries and commission of the sales manager, travellers, agents, training of salesmen, sales correspondents ; the cost of preparing tenders, and estimates for special selling projects ; sales stock shortages ; Rent of Sale Rooms and Offices ; consumer service and service after sales, etc. ; demonstrators and technical advisers to customers or prospective customers.

✓ **Distribution Expense.**—This comprises all expenditure incurred from the time the product is completed in the works until it reaches its destination. Under this heading would be included Warehouse or Finished Stock Store charges, and the cost of transporting goods thereto, packing-cases, loading, carriage outwards, and of goods on sale or return, upkeep and running of delivery vehicles, despatch clerks and labourers, and other items of like nature.

~ **Selling and Distribution Expenses are collected and analysed ?**

- (i) According to the nature of the expense, and also by function, *e.g.* advertising, salesmen, showrooms, storage, etc.
- (ii) By location, *e.g.* representatives' territories, agents, markets, counties, countries, etc. ; by departments, depots, etc. ; or by type or grade of products. For the distribution of such costs various factors may be used, according to which is most suitable as regards incidence. Suggested factors are units of product, weights, values by selling turnover, time, distance, cubic capacity, invoices, and so on. The object is to show the relationship of sales turnover to costs, and the relationship of sales turnover to the potential market. Hence the

18. COST ACCOUNTING AND COSTING METHODS

analysis of sales turnover and of these costs must be on the same basis. The effectiveness of these expenses towards profit earning can then be measured.

✓ **Factory Cost (or Works Cost).**—This is that portion of total cost represented by the sum of the prime cost and expense incurred in producing an article up to the time it is completed at the factory. That part of the general administration and accountancy expenses should be included to the extent that these services are directly connected with the factory as distinct from selling and distribution of the product. Selling and distribution expenses, however, do not form part of factory cost, but do form part of total cost.

✓ **Total Cost (All-In Cost).**—Total Cost, or as it is often called All-in Cost, is the entire expense incidental to production, administration, selling, and distribution.

✓ **Selling Price** is made up of all items included in total cost plus profit added, if any; or less loss, if sold below cost.

METHODS OF COSTING

✓ **General Observations.**—*In the financial books* of an undertaking the whole of the expenditure applicable to a given accounting period is posted in detail from the Cash Book, Journals, and other subsidiary books, to appropriate ledger accounts.

The capital and revenue expenditure, receipts, and credits are shown under suitable headings in the General or Impersonal Ledger, from which the Balance Sheet and Profit and Loss Account are prepared at suitable periods, usually half-yearly or yearly, but in some undertakings even monthly.

In the Cost Accounts the same revenue expenditure is analysed under the headings of the elements of cost, and is allocated to the separate cost accounts for particular orders, jobs, processes, services, or units in such a manner as will assist the management in the control of the business.

✓ **Interlocking or Reconciliation of Cost and Financial Accounts.**

—As the general financial accounts and the Cost Accounts are based on the same total expenditure, it is possible, and necessary, to reconcile the final results shown by the two accounting systems. In doing this allowance must be made for items shown in the financial Profit and Loss Account, but which are not incorporated in the Cost Accounts.

etc., which are more properly treated as deductions from sales receipts.

The use of a Cost Control Total Account, in memorandum form, or an equivalent account included in the double-entry accounting system, is the normal way of effecting the reconciliation, and is considered later in Chapter XV.

✓ **Procedure of Ascertaining Costs.**—The general plan of procedure in all cases involves :

- (i) The compilation in schedules or summaries of all expenditure which has to be accounted for. These provide the totals for the Cost Control Total Account, of which there are various forms.

In some businesses these schedules are prepared in advance of the Financial Accounts owing to the necessity for prompt and early costs. Indeed, the summaries of costs for each accounting period are sometimes used for posting the Financial Accounts, but in the majority of businesses the Cost Accounts and the Financial Accounts are posted independently, although using the same primary detailed information.

- (ii) All expenditure is classified in group totals, and, as necessary, in further sub-groupings. The major groupings follow the main division of the elements of cost. The classification will consequently differ from that usually used in financial accounting.
- (iii) Suitable analysis into departmental or other locational divisions is made. This facilitates sectional control and provides a means of reviewing the supervisory efficiency (or otherwise) of those in charge of various departments, sections, or services.
- (iv) The allocation or charging to all work and services the amounts they have incurred. If the work includes any capital expenditure it is appropriately segregated.

✓ **The Methods of Cost Accounting.**—The general fundamental principles of Cost Ascertainment are the same in every system of Cost Accounting, but the methods of collating and presenting the costs vary with the type of production to be costed.

Seven methods of costing for the ascertainment of *actual* costs may be identified, although basically there are two major groupings: (a) Job Costing. (b) Unit or Process Costing. The names given to the seven methods are used as a convenient means of

referring to the variations of procedure for different types of production.

✓ The methods are :

- (i) *Unit Costing*, formerly known as "Output" or "Single Output" Costing; originally the term referred to the costing of goods.
- (ii) *Operating Costing*. Actually this is Unit Costing as applied to the costing of services. Unit costs may be presented in a variety of aspects in respect of the same expenditure.
- (iii) *Job Costing*, often referred to as "Terminal" Costing. It includes "Contract Costing," a term not now much used.
- (iv) *Batch Costing*, which is a form of Job Costing, a convenient batch of production being treated as a "Job." The batch cost is then used to determine the unit cost of the articles produced.
- (v) *Process Costing*.
- (vi) *Operation Costing*, a method of Unit Costing by operation connected with mass production and repetitive production.
- (vii) *Multiple or Composite Costing*, used when there are a variety of components separately produced, and subsequently assembled in a complex production (e.g. motor cars, aeroplanes).

In addition to costs found by the above methods mention should be made of two other kinds of cost determined for special purposes of control and policy, namely :

- (a) *Standard or Predetermined Costs*.
- (b) *Marginal Costs*.

Any of the above-mentioned methods may be the basis of a *Uniform System of Costing*.

DEFINITIONS

The definitions which follow will serve as a preliminary short general review of the various methods of cost ascertainment and presentation. Detailed descriptions are provided in subsequent chapters.

✓ *Unit Costing*.—Costing by the unit of production where

manufacture is continuous, and the units are identical, or may be regarded as such by the use of suitable ratios.

It may be used in connection with batch, operation, or process costing, and is suitable for such undertakings as collieries, quarries, various kinds of mines, flour mills, steel works, brick and cement works, paper mills, canneries, breweries, etc., in all of which there is a standard unit of production. It is also used for certain types of work in Municipal Costing. Examples of cost units are detailed on pp. 288, 289, and 449.

✓✓ **Operating Costing.**—A method of unit costing of services, such as those afforded by railways, tramways, motor coaches, carriers, gas, electricity, water undertakings, and some municipal services.

✗ **Job Costing** (includes "Terminal" and "Contract Costing").—This method is used to cost jobs or contracts that are kept separate during manufacture or construction. It is applicable to job order work in factories and workshops, and work by builders, constructional engineers, shipbuilders, printers, municipal engineers, etc. The unit of cost is the job, order, or contract, and the accounts show the cost of each order.

✓ **Batch Costing.**—The method of costing when orders or jobs are arranged in batches convenient for production, the batches being regarded as unit jobs for costing purposes. The batch cost divided by the units produced in the batch gives a cost per unit of production. It is useful for biscuit works, bakeries, makers of patent foods, medicines, etc.

✗ **Process Costing.**—The method of costing production by processes in which (a) the product of the process becomes the material of a subsequent process: or (b) where the different products and by-products (if any) are produced simultaneously at the same process: or (c) when the products, differing only in shape or form on completion, are not separately distinguishable from one another during one or more processes of manufacture. Typical industries which may use this method are: those concerned with chemicals, textiles, distilled products, foods, explosives, paints and varnish, etc. The cost of each process, and the costs per unit at each stage, are usually shown by the accounts.

✓ **Operation Costing.**—A method of costing by operations in connection with mass production, repetition work, and other forms of quantity production. It is used in factories where the production is in quantities of standardised lines with the object of working at a minimum cost. There is usually a constant and

uninterrupted flow of production, making use of machine tools and equipment specially designed for each operation, and much division of labour in order to ensure a maximum output at each operation, *e.g.* components for products named under "Multiple Costing" below. It is particularly useful when it is impracticable to separate scrap or waste arising from different batches. A unit cost per operation is ascertained, as well as the cumulative effect at each operation of loss or waste in relation to subsequent operations. This will be illustrated in a later chapter.

Multiple Costing (or "Composite Costing").—A method of costing by combining the costs of component parts of an assembled or aggregate product, separate costs being compiled by one or more of the methods already described for each of a variety of articles manufactured. This method is used in such factories as those manufacturing cycles, motor-cars, engines, wireless sets, machine tools, aeroplanes, and other complex products.

Each of these methods of costing is described in detail in later chapters.

✓ **"Time and Lime" Costing,* and "Cost Plus" Costing.**—These apply to contracts placed with contractors on the basis of cost plus an agreed sum or percentage to cover overhead expenses and profit. The cost refers to direct labour, materials and admissible direct expenses, such as plant hire, transport of materials and plant, etc. Great care is required to see that only agreed and necessary items are admitted to cost, and particularly that items covered in overhead expenses are excluded from prime costs. The method was much used before and during the Great War of 1914 and to a lesser extent in the World War of 1939. It is usually used only when there is need for rapid execution of contracts without waiting for the fixing of definite contract prices. The method is not regarded as satisfactory in normal circumstances owing to the possibility of abuse and the lack of incentive to minimise costs, especially when there is a percentage profit. When the method is used, the accounts are usually scrutinised by accountants appointed by the Authority which placed the contracts.

✓ **"Target" Costs.**—These are used in connection with large constructional contracts, and refer to the method of carefully calculating the anticipated cost, usually by experienced surveyors in consultation with accountants. This anticipated cost

* Often erroneously referred to as "Time and Line," probably due to misquotation in early newspaper references.

is treated as the Target Cost, and on the cost so determined the contractor is paid either an agreed percentage or a fixed sum to cover his overheads and profit. The percentage may be determined by tenders, the lowest being usually accepted, or it may be one agreed directly with a contractor. In order to encourage economical work, it may be agreed to give the contractor a predetermined bonus, such as a proportion of any saving on the target cost.

Clauses may be included in the contract, to provide conditions for unascertainable increases or decreases in specified items such as subsequent rises or reductions in wage rates, prices of materials, etc., and the cost of any required deviations in the work to be added to or deducted from the target cost.

As in the case of cost plus profit contracts accountants independent of the contractor are usually employed to scrutinise the records and accounts. Contracts for supplies may be placed at target prices, on a cost basis with an agreed bonus if target price is reduced.

Standard Costs are costs computed in advance and based on normal or probable expectation. They are later compared with actual ascertained costs from which the management can enquire as to the causes of variations from the predetermined standard costs.)

The method of dealing with Standard Costs and the interpretation of results are dealt with on page 362 *et seq.*

Standard Costs, as well as Uniform Costing, may be used in conjunction with all the methods (a) to (g) above, except (b) Job Costing, when orders are dissimilar and non-repeating.

Marginal Costs.—These costs may be used in connection with most methods of costing referred to above.

(The use of Marginal Costs is a method of interpreting costs of a product at given volumes of output. It will be apparent that certain items of cost and expenses are fixed or constant for each unit produced whatever the quantity, but other costs vary according to the output quantity.)

A marginal cost is the amount of change in aggregate cost resulting from an increase or decrease in the volume of output by one "unit" of production. The interpretation of "unit" will depend upon the industry as to whether this is a single item or blocks of so many items. It is a form of differential cost determined to reveal the incidence on profit of changes in production output.

7. "Expenses should not lose their identity in the expense or on-cost statements." Give illustrations of what is meant by this and say how you would propose to ensure compliance with this principle.—*Royal Society of Arts (Advanced)*.

8. What do you understand by the term "On-cost"? Upon what basis should it, in your opinion, be calculated? State your reasons.—*Chartered Institute of Secretaries (Inter.)*.

9. "The principles underlying all systems of Costing are identical." Enumerate and define these principles.—*Society of Incorporated Accountants and Auditors (Inter.)*.

10. What method of costing (Job, Operating, etc.) would apply to the following industries :

- (a) Coal Mining.
- (b) Shipbuilding.
- (c) Weaving.
- (d) Boot Manufacture.
- (e) Oil Refining.
- (f) Power Station.
- (g) Soap Manufacture.
- (h) Printing.

Institute of Cost and Works Accountants (Inter.).

11. Explain the distinction between Process, Single, and Job Costing; state the industries to which each is suitable.—*London Chamber of Commerce*.

12. What would you take as the unit of cost in the following cases :

- (a) Iron Foundry.
- (b) Electricity Undertaking.
- (c) Machine Tool-makers.
- (d) Brewery.
- (e) Building Contractors.
- (f) Stevedore.
- (g) Railway Company.

Royal Society of Arts (Advanced).

13. Describe briefly the different methods of costing known to you and the type of product to which they are respectively applicable.—*Royal Society of Arts (Advanced)*.

14. Assume three methods of Costing. Job method, Process method and Unit method. What method would you apply in the following industries: Motor-car Manufacturing; Tanning; Electricity Supply; Coal Mining; Weaving; Iron Founding; Boot Manufacturing; Sugar Refinery; Shipbuilding.

State your reasons for the application.—*Institute of Cost and Works Accountants (Inter.)*.

15. Discuss the preliminary steps you would take in installing a complete costing scheme in a factory hitherto without one. Name some of the first difficulties you would expect to arise, and how you would endeavour to overcome them.—*Institute of Cost and Works Accountants (Final)*.

16. What are the main principles of Cost Accounting, and what faults would you expect to find in defective cost accounts? Discuss the latter and show how these are prejudicial to effective management.—*Institute of Cost and Works Accountants (Final)*.

17. What do you understand by the terms :

- (a) Process costs; (b) Operating costs?

In what types of industry do you consider these systems applicable? —*Institute of Cost and Works Accountants (Inter.)*.

18. Set out six items under each of the following classes of expense :

(a) Production; (b) Administration; (c) Selling; (d) Distribution.

What effect on their respective proportions would you expect, when the turnover varies considerably in different periods?—*Institute of Cost and Works Accountants (Inter.)*.

19. Discuss the term "Scientific Management," and state how, in your opinion, the work of the Cost Accountant contributes to its successful operation.—*Institute of Cost and Works Accountants (Final)*.

20. What methods of costing would you advocate in the case of the following manufactures? State reasons.

Ball bearings; Beer; Bicycles; Biscuits; Bricks.

Institute of Cost and Works Accountants (Final).

21. Which type of costing is most suitable for the following undertakings :

(a) Colliery; (b) House Building; (c) Furniture Manufacturing; (d) Cold Storage Plant; (e) Multiple Shop; (f) Oil Refinery?

Give reasons for your answer, explaining what result each system is designed to show.—*Society of Incorporated Accountants and Auditors (Final)*.

22. State which method of Costing you would recommend for use in the following :

(1) Chemical Works; (2) Colliery; (3) Painter and Decorator; (4) Hosiery Manufacturer; (5) Constructional Engineer; (6) Road Transport Company; (7) Paper Mill.

23. What is costing and how would you define "cost"?—*Association of Certified and Corporate Accountants (Final)*.

24. What is the primary function of Cost Accounts, and what do you understand by the term "Cost Accounting"?—*Incorporated Accountants (Inter.)*.

25. Define the following and indicate in which industries or undertakings the different classes could be suitably applied :

(1) Single Costs; (2) Terminal Costs; (3) Operating Costs; (4) Multiple Costs; (5) Process Costs.—*Incorporated Accountants (Final)*.

26. What items are always understood as being included when speaking of the following :

(1) Prime, First or Flat Cost; (2) Total Cost, Gross Cost or Cost of Production; (3) Selling Price?—*Chartered Accountants (Inter.)*.

27. What do you understand by the term "Unit of Cost"? Give the units that you consider most applicable to, or most used in, any four industries known to you.—*Incorporated Accountants (Inter.)*.

28. Into what "types" are Costing systems usually grouped? State the nature of the undertakings to which each type is most suitable, with two examples of each.—*Chartered Accountants (Inter.)*.

29. Name and define the four principal systems of costing, describing the types of business to which each would apply.—*Incorporated Accountants (Inter.)*. X: 812 11 8 4515

30. Define (a) Cost Accounting; (b) Cost Control. Explain their interdependence and the advantages and disadvantages which might be expected to arise from their co-ordination or lack of co-ordination.—*Incorporated Accountants (Final)*.

CHAPTER III

FACTORY ORGANISATION IN CONJUNCTION WITH THE COSTING SYSTEM

Production Efficiency.—The organisation of a factory or workshop has for its aim efficient production—this efficiency being measured by the number of articles produced, the quality and price of the product, and the quickness of delivery. The requirements for successful competition are that production must be expeditious, correct, and at a minimum cost.

The attainment of these objectives demands careful organisation, good management, and the fullest use of plant and the other agents of production. The inclusion of a system of costing provides a reliable means of measuring the extent to which the management succeeds in achieving these objectives.

The Costing system can be so arranged that the management may be aware, not only what the cost of production should be, but also what it has actually been. It provides the only reliable means of collating data and analysing expenditure in relation to production for the guidance of the management. The financial accounts kept will reveal the amount of profit or loss realised, but the information provided by the Cost Accountant goes further than that by indicating where leakages, losses, and waste occur, or where improvements are possible. The function of the Cost Accountant is to assist the Works Manager with information, and to measure for him in money value the results of production. The ascertained cost of all that is done also provides a guide for the future.

The Need for Co-operation.—It is essential that the works system and routine should include arrangements for providing the Cost Accountant with the figures and information necessary for preparing the cost data. A costing system, however good, cannot function properly if the works organisation is unsatisfactory, and, therefore, it is desirable that the system should be drawn up in collaboration with the Works Manager, and, probably, departmental heads, so that full co-operation of all

concerned may be secured. Every effort should be made to eliminate friction and departmental jealousy, and to adopt all suggestions which will tend to make the arrangements run smoothly with the least possible trouble in the workshops.

The Scheme of Administration and Management.—Particular and varying conditions in different industries and works make it impracticable to describe a standard system of works organisation which would be universally suitable, but the principles of works management and organisation can be outlined. For present purposes it will be sufficient to describe the functions of the various departments and officials in a representative works. Others are referred to in later chapters dealing with systems in specific industries. In large works, the duties and responsibilities are shared by more officials than in a small factory, hence, when studying the functions outlined below, it should be noted that in a smaller organisation one individual may combine several such functions within his sphere of responsibility. The main principle to observe is that each person should have his authority and responsibility well defined, so that overlapping of duties does not occur. Provision has to be made for fullest co-ordination and liaison.

THE MAIN DIVISIONS OF MANAGEMENT

✓ The administration of a manufacturing business is usually controlled by a Managing Director, or General Manager, and the main divisions of managerial responsibility can be identified, viz.:

- (i) Secretarial and Financial.
- (ii) Sales and Distribution of the products.
- (iii) Production and Production Services.
- (iv) Design and Research, in large concerns.

The Secretarial and Financial Management is usually the responsibility of the Secretary, or a director of a company, or, in many instances, of the Chief Accountant, or Chief Clerk. The functions usually include :

- (a) Secretarial work, and control of the general office staff.
- (b) The control of financing operations and the ordinary financial books of account.
- (c) Collaboration with the Works Manager in regard to the financing aspect of equipment and production.

The Sales Manager is responsible for sales promotion in its various forms. He devises selling and advertising campaigns,

controls the salesmen, submits estimates and tenders, and is responsible for all statistics relating to sales. He must collaborate with the Works Manager, or Planning Department, as to types and quantities of various goods likely to be required. For estimates and tenders he will consult the Cost Accountant, or, in some cases, the Rate-Fixer, who often functions as an estimator.

The third division—that of Production Management—is the most important from the point of view of this book, and will be considered in greater detail, using for purposes of illustration a large engineering works.

Production Management.—The organisation or production management is co-ordinated by the Works Manager, and the technical control is exercised by the Chief Engineer, or Chemist.

The Works Manager supervises all who are in the chain of control of production, the main sections of which are :

- (i) The Planning Department.
- (ii) The Production Departments, including Stores, Labour Engagement, and Welfare.
- (iii) The Service Departments.
- (iv) The Purchasing Department.

Much of his time is spent in smoothing out the difficulties of his subordinates, and giving decisions when special matters arise in respect of production. He must keep himself well informed of all that takes place in the works, and act as general controller in all matters relating to production.

In particular, the Works Manager usually controls the following sections :

- (1) *Planning Department*, which may be responsible for—
 - (a) Arranging how and where the work is to be done and the issue of instructions.
 - (b) The Progress Department, which regulates the work in accordance with the time-table set by the Planning Department. Sometimes that department determines the sequence of operations, the Progress Department being responsible for the detailed arrangements.
 - (c) The Tool-drawing Office.
 - (d) The Rate-fixing and Time-study Department.
 - (e) The Tool-room, and, sometimes,
 - (f) The Tool Stores. The Tool-room and Store sometimes come under the control of the Production Department.

2. *The Production Department*, which controls

(a) Shop Superintendents, and through them the Foremen and Charge Hands.

(b) Stores Departments, *e.g.*:

* (i) Main Stores of Materials.

(ii) Part Finished Stores.

(iii) Finished Stores.

(iv) Tool Stores, if not supervised by the Planning Department.

(v) Consumable Stores.

(c) Despatch Packing.

(d) Transport.

(e) Labour Engagements and Records, and Welfare.

3. *The Purchasing Department*, which is responsible for dealing with replenishment requisitions from the Stores: and for the securing of special direct material.

4. *The Inspection Department*, if not controlled by the Engineer (see below).

The Chief Engineer supervises the technical side of the works, and acts as technical consultant to almost every section of the works. He designs the articles to be made and any variations arising out of special specifications. It is his duty to study the latest technical information, and to propose improvements in design and materials, after proper research and experiment, if necessary in conjunction with the Works Chemist.

The departments he is responsible for are :

(1) *The Drawing Office*.—Under the instructions of the Engineer, working drawings are prepared, and the necessary blue-prints for use in the shops. A carefully indexed file of drawings and blue-prints is kept. The Tracers and Blue-print Room are supervised by the Chief Draughtsman.

Specifications of Material (sometimes called Bills of Material) suggested by the Engineer are prepared, and orders pass from the Engineer's Department to the Drawing Office and Planning Department for the issue of instructions.

(2) *Experiment and Research Department*.—New designs, improvements, and new methods are tried out in this department. It is also responsible for testing materials, and examining them to ascertain whether they conform to specification.

* The stores are sometimes under the Control of the Cost Accountant, or Financial Officer. The control is twofold: (a) financial, (b) physical.

Various physical and chemical tests may be necessary, especially where metals and chemicals are used in the process of manufacture.

(3) *Inspection Department*.—The Chief Inspector must of necessity be a technical man who understands all manufacturing operations to enable him to trace reasons for defective work. Inspection duties can be divided into four sections.

- (a) Inspection of purchased raw materials. Examination is made as to dimensions, tensile strength, chemical composition, finish, or other factors mentioned in the purchase specification. It should be noticed that the finished product of one industry, or department, may be the raw material of another.
- (b) Inspection of goods purchased in a partly finished or machined condition. The examination is made to see that the articles agree with the specification. Where gauges have been supplied, copies will be used to test the articles, in addition to inspection of the general finish.
- (c) Inspection of finished parts, or components, made in the factory. This may be conducted after every operation or process; but if this cannot be done without unduly large expense, the finished part is examined on completion. Each person examining will stamp or otherwise impress the articles with his own identification mark.
- (d) Inspection of finished products for stock or despatch. Each part assembled is examined, *e.g.* the painting, polish, and general appearance, the fit if applicable, and the correct components or accessories. Quantities are also usually certified by the Inspection Department showing the quantities rejected.

DEPARTMENTAL PROCEDURE

The Planning Department.—This department relieves the foremen of many responsibilities, and co-ordinates production by providing the plan of procedure and time-table for the whole works. Arrangements are made for the passing of each order through the shops. Not only the route but also the machines to be used are specified, and the supply of requisite materials is ensured.

Attention has to be paid to machining and handling methods, and to the volume of production which can be coped with by

each department or shop. In matters of cost, the Cost Accountant has to be consulted, particularly in regard to alterations in procedure.

The Progress Department is responsible for the details of manufacture which have been arranged by the Planning Department. The latter will plan the sequence of operations, and the Progress Department details the particular machines to be used, regulates the work, and maintains its movement to time through every stage of manufacture. The Progress Department makes sure that materials required are in stock, or that specially purchased material is delivered to time. It obtains the specifications of materials and drawings from the Drawing Office, and sees that any necessary jigs or tools are available. Where special tools are required, drawings will be made and orders given for the making of the tools. Schedules are prepared for every movement of the work, so that the progress man knows what work is on each machine, and can be making preparations for the next job to follow. Graphic charts are often used, the Gantt Charts being particularly appropriate (see p. 434).

The Tool-Drawing Office is another part of the Planning Department, which is generally separate from the main Drawing Office.

The jigs, gauges, and tools required by the Planning Department are designed in the Tool-Drawing Office.

The Tool-Room is the department which produces the jigs, gauges, and tools required by the Production Department. It examines tools returned from the shops, and reconditions them if this is necessary. The foreman in charge is usually a highly skilled man, and he is provided with machine tools, special furnaces for hardening, etc., and various instruments for measuring accurately. All tools made or returned from the shops are passed to the Tool Store, from which they are only issued on presentation of formal requisitions (see Ch. XIV).

The Rate-Fixer in some works may perform some of the functions of the Planning and Progress Departments. He may decide whether day- or piece-work is to be used, indicate the time allowed, and is responsible for fixing time or price rates for each piece or operation not produced or paid by ordinary time-work rates. A careful investigation is made in detail for every operation; timing is made with the aid of a stop-watch, and a reliable average time fixed, and, finally, the piece-work or premium-bonus rate. All factors

which affect the work are considered, including the type of machine, its speed, and the kind of material to be worked upon. It is apparent that the Rate-Fixer must have a practical working knowledge of every machine, and thoroughly understand tool design. Careful enquiry into motion study methods, as advised by industrial psychologists, may lead to better results.

Production Department.—Immediately responsible to the Works Manager are the

Works or Shop Superintendents.—Each has one or more producing shops under his supervision and control.

Where there is a Labour Engagement Department, the Works Superintendent may be responsible for authorising the engagement of workers requisitioned by foremen. His chief duties are: representing the Works Manager, attending to matters delegated to him, and supervising the conduct of the shops for which he is responsible.

The Foreman is mainly concerned with supervision of the men and work in his shop. Through him all instructions and works orders pass to the workers, and his duty is to see these are duly and correctly carried out.

The foreman will see that proper shop records are kept of orders handed to the workers, and that time spent on each is correctly booked. The modern practice is to have this work done by a clerk assisting the foreman.

The work done in his shop will generally be inspected by him or his assistant, and he will see that machines are kept running, reporting defects to the Repair Department. In large shops, charge-hands may assist the foreman.

The Storekeeper is responsible for the care and custody of materials, and sometimes of finished stock. He must see that all materials are kept in an orderly manner, and that quantities are maintained in accordance with the maxima and minima which have been fixed by the management. Proper records of receipts and issues must be kept by him. He must see that nothing is issued, except on presentation of a duly authorised requisition. He is responsible for these requisitions being sent daily to the Cost Office.

If departmental stores are kept, in addition to the main stores, an assistant storekeeper will be in charge of each. Stores procedure and organisation will be dealt with in a separate chapter.

Stores Audit.—It is usual to have a continuous check on


The Wages and Timekeeper's offices are usually under the control of the Cost Accountant, at least in so far as the calculation of times and amounts payable are concerned and the form in which records are entered up. The timekeeper is directly responsible for the recording of the times of workers, computing time and overtime, and the operation of attendance time recording devices. The Wages Office, from details supplied by the timekeeper, or from work tickets, makes up the pay-roll from which the Cashier pays. The detailed procedure of these departments is described in Chapters VI and VII.

Production Departments or Shops, and Production Services.—Production Department is the term used to connote the department in which the actual product for sale is manufactured or produced, in contradistinction to the service departments that are ancillary.

A *Production Service* is a facility available to a production department.

Examples are : Repair and Maintenance, and Power Services : Electricity, Gas, Water, Hydraulic Pressure, Compressed Air, Vacuum, and Steam. Some pharmaceutical factories have a service of distilled water to all departments.

Plant Maintenance includes routine inspection of plant, tools, and equipment at regular intervals for avoidance of breakdown by prompt replacement and repairs at convenient times instead of when emergencies arise. It is sometimes referred to as Preventive Maintenance.

The Organisation in Other Types of Industry will naturally vary, particularly as regards production management. Thus, in the chemical and certain food manufacturing factories the works manager is a chemist, whilst inspection assumes the form of laboratory analysis and various kinds of testing at successive stages of production, and of the final product. Research for new chemicals, drugs, and combinations of ingredients ; for new processes and methods ; or for improvement of existing lines, or of plant is a continuous and costly part of the organisation. There are also special features as regards the control of stores materials, particularly when costly, and sometimes dangerous, chemicals and drugs are concerned. Various aspects of these and other industries are dealt with in the author's treatise* on *Applied Costing in Selected Industries*. 

* By the same publishers.

EXAMINATION QUESTIONS

1. By means of a suitable chart, describe the route through the works taken by an order from its reception, during all stages of manufacture, to its completion ready for despatch.—*Institute of Cost and Works Accountants (Inter.)*.

2. What scheme would you adopt whereby the Drawing Office, Planning Department, Jig and Tool Department, Estimating Department, and Design Office can have advantageous service from the Cost Accounts?—*Institute of Cost and Works Accountants (Final)*.

3. What method would you employ to ensure that all requisitions finally reach the Cost Department?—*Institute of Cost and Works Accountants (Inter.)*.

4. What steps would you propose should be taken to avoid discrepancies between store-house records and the stores ledgers in respect of issues of materials and stores?—*Institute of Cost and Works Accountants (Inter.)*.

5. "No system of costing will prove successful if the organisation of the factory is bad." Comment on this statement. Who is the officer directly responsible for the organisation of a factory, and what is the extent of his control and responsibility? Why are his methods of importance to the Professional Accountant?—*Society of Incorporated Accountants and Auditors (Final)*.

6. Describe the functions performed by departments responsible for controlling labour costs and maintaining personnel records in a manufacturing concern.—*Institute of Cost and Works Accountants (Inter.)*.

CHAPTER IV

PURCHASING AND STORES DEPARTMENTS PROCEDURE

Introductory.—In each industry, and in different works within an industry, the detailed organisation will vary according to particular conditions and ideas, but the general procedure and principles outlined in this chapter may be regarded as typical, although particularly suitable for an engineering or similar factory. The forms used as illustrations are based on some actually in use, but again will vary in ruling and wording to suit particular needs.

The storekeeper's duties are important, and the position is a responsible one. In his care are materials representing large sums, and he must see that these are safely stored, arranged in an orderly manner and accessible, all receipts and issues being properly recorded, and re-ordering promptly dealt with.

Quantities and kinds of materials will be decided upon by technical managers, the usual custom being to fix a maximum and minimum quantity of each material to be carried.

It is usual to keep separate stores for part-finished stocks, finished parts, finished stocks, raw materials, and consumable stores. In large works, it is sometimes the practice to have departmental stores for materials regularly required in the respective departments, supplies being drawn from the main stores. In such cases, an assistant storekeeper is in charge. Generally speaking, it is inadvisable to place departmental stores under the care of the foreman of the department.

The definitions of the kinds of stock are :

Raw Materials.—Primary materials purchased or produced, either in a natural or manufactured condition. Manufactured materials of one industry are often the raw materials of another.

Bulk Material is a term often used to describe material not in unit form directly suited to the work in hand, as, for instance, material not measurable except by weight or volume, sheets, bars, tubes, and bales.

Part-Finished Stock is work in progress that has not reached the stage of completion as a part or component. In the case of some chemical or food manufacturing processes the work in progress often consists of quantities of part-processed material or intermediate products.

Finished Parts are items, or sub-assemblies, put into store awaiting final assembly, or sale as spares. The term "components" refers to the separate pieces entering into a complete product.

Finished Stock is the completed product awaiting sale or despatch. Stock is so named after transfer from Work in Progress, physically and by entry in the accounts. Sometimes termed: Finished Stores, Completed Stock or Manufactured Stock.

Scrap Material.—Residue of materials, raw or manufactured, and spoilt materials arising in the course of manufacture, which are of no use for their original purpose.

Indirect Materials are those used which cannot be directly charged to, or traced as part of, the product. Under this heading are included materials consumed in operating and maintaining the equipment, and which are chargeable against current manufacturing. They are often referred to as *Consumable Stores*, and include such items as: lubricants, waste, belt fasteners and dressings, cleaning materials, hand tools, and works stationery, which are chargeable to expense accounts.

Classification Code for Materials.—The use of material specification code numbers is an advantage, not only to the Purchasing Department and Drawing Office, but also to the pricing clerk in the Works Office, in that ambiguity is eliminated. The code should consist of symbols and numbers, the symbol indicating a material or an item, and the number the size, pattern, etc. A simple example will make this clear. Screws, brass, and steel could be given the symbols B.S. and S.S. respectively, a number being added for each size, the first is sixteenths, the next two-lengths in eighths:

B.S. 403 = Brass Screw	$\frac{1}{4}'' \times \frac{3}{8}''$	S.S. 403	} = { Steel screws of the same sizes as stated for brass.
B.S. 704 = " "	$\frac{1}{8}'' \times \frac{1}{2}''$	S.S. 704	
B.S. 507 = " "	$\frac{1}{16}'' \times \frac{7}{8}''$	S.S. 507	
B.S. 414 = " "	$\frac{1}{4}'' \times 1\frac{3}{4}''$	S.S. 414	
B.S. 418 = " "	$\frac{1}{4}'' \times 2\frac{1}{4}''$	S.S. 418	

The use of index letters for the purpose of identifying parts is illustrated in Fig. 62.

All standard articles will have identifying symbols and

numbers, and, although the system may appear complicated, it will be found, in practice, that storemen, clerks, and draughtsmen find these codes easy to work with, since the code numbers of the more frequently used materials are readily memorised. In the Cost Office the pricing of issued material is facilitated and uncertainty as to size and kind of material is avoided.

In the Bills of Material prepared by the Drawing Office, stock materials are indicated by the appropriate code number, but full details have to be specified for special parts and materials which have to be manufactured or purchased outside.

The procedure for requisitioning, buying, and issuing materials will now be described.

Purchase Requisitions for Materials.—The Purchasing Department places all orders for materials and supplies in accordance with requisitions received from

- (a) The storekeeper for all standard materials, the stocks of which require replenishment.
- (b) The engineer, or Drawing Office, for special materials required for particular orders, but which are not ordinarily stocked.

Requisitions from the storekeeper are generally countersigned by the Works Manager, and those from the Drawing Office by the Chief Engineer, or the Works Manager.

The Drawing Office issues Specifications of Materials (often called Bills of Materials) for the guidance of the buying and other departments.

Purchase Requisitions—Form and Procedure.—The storekeeper, or other official, writes each purchase requisition in triplicate, the sheets being supplied in carbon manifold sets. He signs this, and passes it to the Works Manager for approval. One copy is sent to the buyer, one to the Progress Department, and one is retained by the storekeeper.

A suitable kind of requisition is shown in Fig. 1.

The storekeeper is guided, when requisitioning for stock, by the maximum and minimum quantity which he is authorised to work to in respect of each kind of material. The minimum stock for any article will be fixed by taking into consideration the rate of consumption, and the time necessary to obtain new deliveries.

The maximum stock is fixed by taking into account such further aspects as (a) keeping qualities, (b) storage space available, (c) extent to which price fluctuations may be important,

and will indicate the usual market units, so as to avoid requisitions for irregular quantities. Sometimes an "ordering level" is stated. This is the point in the reduction of a stock commodity when action to replenish should be taken. This point will depend upon the margin of time necessary to cover fluctuating consumption demands and possible abnormal delays by suppliers for replenishments.

Special Purchase Requisitions for direct materials for specific jobs are prepared by the Drawing Office; or, for standardised repetition work, the Planning Department may requisition on the basis of the original specification of material prepared by the Drawing Office. A Specification of Material (also known as a Bill of Material) is drawn up for special work by the Drawing Office (see Fig. 3). On this, stock material is indicated by code numbers, and the special material shown on it will be the subject of a special purchase requisition (see Fig. 2) which is sent to the Purchasing Department. Suitable brands or particular suppliers may be specified.

Specifications of Material (Bills of Material).—A Specification of Material is a complete schedule of parts and materials required for a particular order, prepared by the Drawing Office, and issued by it, together with the necessary blue-prints of drawings. For standard products, printed copies of the Specification of Material may be kept in stock—there being blank spaces for any special details of modifications for a particular job.

The schedule details everything required, even to nuts, bolts, and screws, as well as weights and sizes.

A copy is retained in the Drawing Office, and one each is provided for the Purchasing Department, the Planning Department, and the foreman.

An example of a Specification of Material is shown in Fig. 3.

Organisation of the Purchasing Department.—The buyer in a manufacturing business has considerable responsibility, and, in a large concern, much money can be lost or saved by his department.

He requires a good technical knowledge of the industry, and a large measure of administrative and organising ability; he must keep in constant touch with market prices, reports and market tendencies, and have a working knowledge of contract law and procedure, and a practical understanding of the principles of economic laws.

In reference to the materials usually used, he should be

FIG. 3.

SPECIFICATION OF MATERIAL.

Number 254.

For Order No. P.O. 206. Electric Motor No. 7. Assembly Drawing No. 39. Date : 20 February, 19...

Symbol No. of Parts.	Description.	No. per set.	Total No.	MATERIALS.			Remarks.	FOR PURCHASE DEPARTMENT.			
				Code No.	Description.	Quan- tity.		Reqn. No.	Date.	Deliveries Specified.	Order No.
E.M. 3 C. E.M. 3 B.	Iron casing Core plates	2	2	M. 16	Standard	2	Stock Japanned wrought iron Stock Ref. 270	72	28/2	5/3	273
		10		P. 14	Slotted open type	20					
E.M. 3 F. F.C. 7	Frame End rings Iron cylinder, etc.	1		M. 15	Cast iron	1	Stock " " " " St. 243	72	28/2	5/3	274
		4		S. 27	Standard Parkinson	4					
P.M. 81	Ring bolts Nuts, $\frac{1}{2}$ " Nuts, $\frac{3}{8}$ " Brass cups Brush holders, etc.	4		B. 9	Standard	8	Stock " " " " St. 243	72	28/2	5/3	274
		4		S.N. 4	" "	16					
		2		S.N. 5	" "	2					
		2		B.O. 2	" "	2					
		3	12	—	Thompson	12					
Drawing Office Copy.	Date Order : 24 Feb., 19... Delivery : 10 Mar. No. of Sheets : 4			Prepared by : J. H. Ross. Checked by : C. F. Davis.				Dated to stores : 20 Feb., 19... " from stores : 29 " " " to shops : 7 Mar., 19...			

Note.—This schedule is often referred to as a "Bill of Material."

provided with a schedule of technical specifications, each item having a code number which will be quoted by those issuing purchase requisitions.

The department should keep files suitably indexed, both under the names of suppliers and materials. Records of prices and quotations for all materials should be kept in schedule form, arranged to show the seasonal and other movements of prices. (See Fig. 5.)

The systematic following up of deliveries by due date is important, and necessitates the prompt marking off of deliveries from the Goods Received Notes.

No purchases should be permitted, except upon receipt of duly authorised purchase requisitions, but, in the case of materials largely and regularly used, forward contracts may be made after consultation with the management. Where purchase contracts are placed, a record of orders issued against them and deliveries made should be kept. (Fig. 4.)

FIG. 4.

PURCHASE CONTRACT RECORD							File No. : 87.
Material : 1" Copper Tubes. Suppliers : Tube Mfg. Co. Contract No. : 261/22 June, 19... Completed : 25 Sept., 19...			Quantity : 20 Tons. Price : £72 per Ton. Free delivered. Net monthly. Total Cost : £1440.				
ORDERED.			DELIVERED.				
Date.	Quan- tity. (Tons.)	Balance to Order. (Tons.)	Date.	Quan- tity. (Tons.)	Current Price. (Per (Ton.) £	Value. £	Balance to Deliver. (Tons.)
19...			19...				
June 22	5	15	July 7	5	73	365	15
July 10	4	11	" 12	2	73	146	13
Aug. 20	11	—	" 30	2	74	148	11
			Aug. 14	5	73	365	6
			" 21	2	75	150	4
			Sept. 8	4	74	296	—
	20			20		1470	

Procedure in the Purchasing Department.—On receipt of purchase requisitions the buyer will obtain quotations, or, for important requirements, may invite tenders for the supply of the materials required.

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Consideration has to be given to more factors than price—namely, to specifications, conditions of delivery, various charges, times of delivery, terms of payment and discount. A good plan

FIG. 5.

SCHEDULE OF QUOTATIONS

File No. : 32.

Material : 1" Copper Tubes Date : 20 June, 19...

	Rate. £	Amount. £ s. d.	Time for Delivery.	Terms.	Deliv- ery.	Remarks.
Estimated cost or part price.	76	1520 0 0				
1. Hall & Co.	75	1500 0 0	7 days	Net monthly	Free	
2. Tube Mfg. Co.	72	1440 0 0	14 days	"	"	Accepted
3. Copper & Co., Ltd.	76	1520 0 0	4 weeks	"	"	
4. F. White & Co.	80	1600 0 0	10 days	"	"	
5.						

is to prepare a schedule of quotations to facilitate comparison (see Fig. 5), and to file this for reference on subsequent occasions.

A Purchase Order (see Fig. 6) is then written, preferably in triplicate, the original being sent to the supplier, the duplicate to the stores receiving clerk—the third copy being retained for

FIG. 6.

PURCHASE ORDER.

ORDER.		No. 4721.	
To Messrs. Smith, Jones & Co., Birmingham.			
From A. Maker & Co., Ltd., Star Works, London, N.W.			
Our ref. : Req. 284.		Date : 28/2/19...	
Please supply, in accordance with the instructions herein, the following :			
Particulars.	Price.	per	Delivery.
2 tons $\frac{3}{8}$ " Mild Steel Bars, round.	£x	ton	At once
<p>Delivery free at our Works. Mark Order No. on invoice and advice note. Terms : 5% Monthly Account.</p> <p style="text-align: right;">For A. Maker & Co., Ltd. C. Davis.</p>			

reference purposes. The duplicate is useful for comparing with delivery notes, and for noting upon it the deliveries. Sometimes a duplicate is sent to the suppliers for confirmation purposes.

In some factories a Goods Ordered Book is kept, one page being allotted to each kind of material. It is ruled for recording the name of the supplier, the quantity ordered, description, price, order number, terms, and delivery date. (See Fig. 7.)

FIG. 7.

GOODS ORDERED BOOK								Page 76.	
Material: Blue Wove.									
Specification: Tub-sized, 18 lbs.								Code No.: H. 14.	
Date of Order.	O/No.	Suppliers.	Quantity.	Price.	Terms.	Deliv. due.	DELIVERED.		Total.
							Date.	Quantity.	
19... Jan. 6	31	Sun Paper Makers, Ltd.	10 tons	6d. lb.	net monthly	Feb. 10 2 tons, bal. by Mar. 31	19... Feb. 10 " 26 " 28	2 tons 3 " 5 "	Tons. 10
Feb. 9	48	" X " Paper Mill, Ltd.	20 tons	5½d. lb.	do.	Apl. 20, bal. by May 2	Apl. 19	5 tons	5

The following up of deliveries on or before due date is important, and may be the duty of the storekeeper, or the Purchasing Department. If the receiving clerk's copies are filed according to the stated dates of delivery, he will know what materials to expect each day, and, when deliveries are made, the copy order can be marked with particulars of delivery, and returned to the buyer to mark off.

Procedure on Receipt of Materials.—Suppliers usually send a delivery note, or an advice of despatch, which is passed to the receiving clerk. Invoices received are passed direct to the office.

Full particulars of the goods should be entered in a Goods Received Book, or, preferably, on a Goods Received Note (see Fig. 8). The advantage of Goods Received Notes is that, after being filled in with particulars as to quantities and other information, they can be passed to the official responsible for approving the goods, who signs the notes, and sends them with the goods to the storekeeper. The receiving and approving of goods is sometimes the duty of the storekeeper himself, in which case

ber, G.R. No., and signs for the correctness of the particulars, which he is able to check with his order, and the certified Goods Received Note. He should mark the Order-Book copy with the invoice number to preclude the passing of a duplicate invoice.

The calculations are checked in the Works Office, and the proper debits made to the appropriate material account in the Stores Ledger, except in the case of material purchased for a specific job, when the debit is made to the Cost Account for that job. In this office also the price and amount are entered on the Goods Received Note, the description and quantity previously entered by the receiving clerk being checked at the same time.

The invoice is duly passed to the Accounts Office for entry in the Purchase Journal, from which the suppliers' Account is credited in the Bought Ledger. The respective totals of the columns in the Purchase Journal are debited in the Impersonal Ledger to the various accounts concerned. The detailed procedure for accounting and specimen entries are given in a later chapter.

Need for Reconciliation of Totals Debited.—In view of the ultimate need for reconciliation of the Cost and Financial Accounts which is discussed in Chapter XV, it should be noticed that so far as materials are concerned there must be a precise agreement between the total values entered in the Stores Ledger from the primary details entered on the Goods Received Notes, and the amounts incorporated in the financial accounts from the subsidiary books compiled from the suppliers' invoices. This is particularly necessary when the suppliers' invoices are not used in conjunction with the Goods Received Notes when the Stores Ledgers are entered up.

EXAMINATION QUESTIONS

1. State fully the duties and responsibilities of the storekeeper in any business with which you are familiar.—*London Chamber of Commerce.*
2. State briefly the main features of a suitable system for the Stock records of a factory, including the relations between these and the costing and general financial records.—*Institute of Chartered Accountants (Final).*
3. What do you understand by maximum and minimum stocks and ordering level?—*Royal Society of Arts (Advanced).*
4. Describe in detail a method of controlling the replenishment of stocks of manufactured component parts.—*Institute of Cost and Works Accountants (Inter.).*
5. State briefly the main features of a system for the Stock records of a factory, including the relations between these and the costing and financial records.—*Institute of Chartered Accountants (Final).*

6. In many manufacturing businesses the materials used in the production of manufactured goods are obtained from general stores by requisition. The requisition notes are the means of securing information of direct materials chargeable to the cost of particular products. In some instances, purchases of materials are made for specific contracts and are relatively useless for general purposes. The materials thus purchased, however, pass through the Stores and are requisitioned as required. State what difference would be observed in the Stores Ledger records between such general stores and stores specially acquired for a specific contract. In the latter case, how would you propose to deal with the small surpluses of material which inevitably arise? What objection would there be to including these surpluses in the annual stock-taking valuation?—*Association of Certified and Corporate Accountants (Final)*.

7. Do you consider that the storekeeper should see and pass invoices for material received? What alternative method is suggested for checking the quantities and prices?—*Institute of Cost and Works Accountants (Inter.)*.

8. In connection with a stock record the term "ordering level" is sometimes used. In what way does this differ from the terms "minimum" and "maximum" stocks?—*Institute of Cost and Works Accountants (Inter.)*.

9. What are the factors which determine the maximum and minimum figures for stock control? Illustrate your answer with examples.—*Institute of Cost and Works Accountants (Inter.)*.

10. Describe a system that would definitely link up the Purchasing Department, Goods Receiving Department, and Cost Department; giving all information for passing invoices, checking goods received and posting to Costs.—*Institute of Cost and Works Accountants (Inter.)*.

11. State what arrangements are necessary for installing a stores requisition system of material control in a factory where such a system has not been in use.—*Institute of Cost and Works Accountants (Final)*.

12. A company has a finished goods warehouse at its factory in Bristol and a sales depot in Glasgow. List each stage in the routine procedure for quantity control, from the time when Glasgow realises the need for a quantity of an article until the quantity is received.—*Institute of Cost and Works Accountants (Inter.)*.

13. A general stores with a large variety of stock items has a printed catalogue giving names and part numbers. Discuss the advisability of quoting numbers and/or names on the requisitions, and the occasions on which numbers or names should be used separately.—*Institute of Cost and Works Accountants (Inter.)*.

CHAPTER V

STORES ROUTINE

Receipt of Materials.—Purchased materials are passed into the custody of the storekeeper when they have been examined and approved. The storekeeper checks the quantities with the Goods Received Note, which he signs. When the storekeeper is directly responsible for receiving goods he will prepare the G.R. Notes.

Some articles or parts for stock are not purchased from outside suppliers, but made in the works. These will be inspected in the usual course, and are then passed into the stores. In order to keep the accounting uniform, it is desirable that a Goods Received Note be prepared for these articles. The necessary debits and credits, as between production and stores, will be dealt with by the Cost Office.

Issue of Materials.—Nothing should be issued by the storekeeper, except on presentation of a Stores Requisition. (Fig. 10.)

Fig. 10. ✓

STORES REQUISITION								No. 76.
Materials Required for : Job. E 513. (Job or Process.)								
Department : Engines.								
								Date : 20 July, 19...
Quantity.	Description.	Code No.		Rate.	£	s.	d.	Notes.
10 ft.	1" Brass X.E.D.	B 102	12 lbs.	1/- lb.		12	0	
Foreman : F. Simpson. Workman : E. Barry.		Shop E. 3.	Storekeeper's initials : A. S.		Cost Office ref. : MA 364. Stores Ledger Fo. : 218.			

Note.—The pricing out is done in the Cost Office.

A Stores Requisition is an authorisation to the storekeeper to issue raw material, finished parts, or other stores.

These forms are generally issued and signed by the shop foreman, but sometimes, in the case of special jobs, the particulars are determined by the Planning Department.

The Receipt and Issue of Special Materials (Material Allocation).—Materials ordered for a specific job will be marked with the job number, and kept apart ready for issue. The foreman will be informed that the material is available. A good plan for this is for the Production Department to prepare a Stores Requisition, and send it to the foreman, who can sign it, and present it at the Stores when he is ready to use the material.

Stores Records.—Two records are usually kept of materials received, issued, or transferred—namely, on the Bin Cards, or Stores Control Record, and in the Stores Ledger. The Bin Cards (or Stores Control Record) are written up in the Stores, but the Stores Ledger is sometimes kept by the Cost Department, or a stores office.

There is considerable advantage in this procedure, as it leaves the storekeeper with the minimum amount of clerical work, and the Stores Accounting Records are kept cleaner and more accurately by an experienced stores clerk.

A Stores Appropriation Record is often kept when it is not convenient to work to definite maxima and minima of certain types of material which may be required to meet orders. It may be used in connection with stores materials, or components, which are made in the works, and also ordered from outside, and is of great value to the Planning Department, in that it shows the quantity in stock and on order. The record may be combined in the ordinary Stores Control Record by providing a special column for the purpose, or a separate Stores Appropriation Ledger may be used. When the latter is adopted, the procedure is to debit each account with the quantities in stock and ordered. As a quantity is appropriated, it is credited, and the balance represents the quantity in stock and on order.

Finished Parts or Components Store.—These are items or sub-assemblies put into store awaiting final assembly or sale as spares. It is not unusual to keep these parts in a separate store, under the control of the Progress or Planning Department. It is usual to keep a Finished Parts Stock Record indicating the quantity and also in some cases the value of each class of finished part and its location in the stores. Stock orders for quantities of standard parts will be issued in batches convenient for economical manufacture. A Stores Appropriation Record is

useful for the control. The cost, ascertained from the Works Order for the production of these stock orders, will ordinarily be the charging-out price, when components are issued on requisition for assembly on various Works Orders.

Transfers of Materials.—Transfers of materials from one departmental store to another should be recorded by means of a Stores Requisition signed by the storekeeper, and marked "Transfer." This memorandum can then be used in the office for the making of the necessary credit and debit.

Where transfers are numerous it is sometimes the practice to have special columns in the Stock Record Sheets or Bin Cards for recording the details of the transfers.

The transfer of material from one job to another in the works should be strictly prohibited, unless adequate procedure is arranged for a Material Transfer slip, showing all necessary data for crediting and debiting the cost accounts affected, as otherwise the records and cost accounts concerned would be incorrect. Such transfers occur where an urgent order has to be made and work started on a less urgent order may be appropriated. In such a case there must be provision for the re-issue of material to the job from which material already issued has been transferred. For excess material, the proper procedure is to return this to the Stores, when a Shop Credit Note can be made out.

Material Issued in Excess of Requirements.—Bulk material has to be issued at times in excess of the needs for a particular job. For instance, sheet iron or steel bars, which cannot be cut off in the Stores to the exact size required, or which can be more advantageously operated upon in the works when full size. The procedure is to charge out the full quantity issued, and, when the excess is returned to store, a Stores Debit Note is filled in, signed by the foreman, and handed to the storekeeper.

A *Stores Debit Note* is an authorisation to return to the storekeeper raw material, finished parts, or other stores no longer required by the factory. It is sometimes referred to as a Shop Credit Slip.

The various stock records and cost accounts are adjusted in due course from the details given on this form.

These debit notes may be drawn up in the same form as a Stores Requisition, but printed in red to distinguish them.

Bin Cards.—Materials are kept in appropriate bins, drawers, or other receptacles; some are stacked, others racked. For

STOREKEEPER'S MATERIAL CONTROL RECORD

[illegible]

27. Describe what you consider to be an adequate system of checking the receipt of goods and payment for them.—*Institute of Cost and Works Accountants (Inter.)*.

28. The moving of material from stores to, and in, departments involves both labour and overhead expenses. Do you consider these should all be recovered by a direct charge against material or as a departmental overhead? Briefly explain your reasons for the method you suggest.—*Institute of Cost and Works Accountants (Final)*.

29. In a factory where "continuous stocktaking" is carried out periodically, discrepancies are discovered. Suggest possible causes of these discrepancies.—*Association of Certified and Corporate Accountants (Final)*.

30. Briefly describe a system of recording the receipt and issue of goods from store to departments in any manufacturing business with which you are familiar.—*Chartered Secretaries (Inter.)*.

31. In most factories many small parts, such as bolts, screws, nails, washers, etc., are used in large quantities in the process of manufacture. The parts in question are usually purchased by weight, and the price thereof may fluctuate considerably.

Outline a system by means of which the correct price at which such items should be charged in the factory costing records may be determined in order to prevent serious discrepancies between the total value of Stocks on Hand and the balance of stores purchased and issued. Include as part of your answer a specimen ruling for the Stores Ledger recommended to be used.—*Incorporated Accountants (Final)*.

32. How would you record tools issued and returned? Who should authorise such issue?

What provision would you make in respect of such tools where a workman is transferred to another department, and where tools are lost or broken? Draft a workman's Tool Book.—*Incorporated Accountants (Final)*.

33. A manufacturing company secures a contract necessitating the use of 20 tons of zinc sheets. Trace the procedure to be followed in the office and in the works in order that this material may be available, giving specimens of any two of the forms you would expect to be used. The price of the zinc sheets purchased would be about £24 per ton.—*Incorporated Accountants (Inter.)*.

34. The following comparisons have been taken from the Material Control records of a company:

	MATERIAL A.		MATERIAL B.		MATERIAL C.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Bin Card	20	£ s. d. — — —	4	£ s. d. — — —	20	£ s. d. — — —
Stores Ledger	40	20 0 0	—	10 12 6	25	— — —
Perpetual Inventory (Physical Count)	15	— — —	5	— — —	20	— — —

Surmise as to the causes of these discrepancies and state how you would investigate them.—*Institute of Cost and Works Accountants (Inter.)*.

35. Manufacturers Ltd., charge stores out to jobs on the basis that the first received are the first issued. Among the stores stocked are "K-type" screws, on which a provision for spoilage by rust (based on experience) is made of 1% of the Stores Account balance at the beginning

of each month. Stock is taken physically at three-monthly intervals, and the balances of the Stores Accounts are appropriately adjusted.

On August 1st the stock of K-type screws was 10,000 of which the cost was 19s. per 100. During the next three months the transactions were as follows :

		Purchases.		Issues.
		Quantities.	Price per 100.	
August	.	40,000	20s.	36,600
September	.	80,000	22s.	81,367
October	.	100,000	24s.	72,282

At the end of October stocktaking revealed a shortage of 300 screws, and during November all the stock was destroyed by a flood.

You are required :

- (a) To write up the K-type screw Stores Account for the three months ended October 31st, and
- (b) To state how you would deal in the company's accounts and costings with : (i) the screws spoiled by rust ; (ii) the shortage in the stock revealed by stocktaking ; and (iii) the destruction of the stock by flood.—*Chartered Accountants (Final)*.

36. During periods of rapid increase or decrease in prices of materials used in production, which of the following methods of pricing stores issues results in the most accurate costing of goods manufactured and sold :

- (a) First-in, first-out method ;
- (b) Actual cost method ;
- (c) Average cost method ;
- (d) Last-in, first-out method ;
- (e) Standard cost method ?

Give reasons in support of your answer.—*Institute of Cost and Works Accountants (Inter.)*.

mechanical for manual methods of time-keeping and time-booking has rendered records more exact ; whilst the uses to which time-recording instruments may be put have revolutionised costing procedure.

The uses of time-recording clocks will be described under two sections : (1) Gate or attendance time records ; (2) Job-time records.

Attendance time-recorders are usually installed near the main entrance, but in extensive works may be placed near the entrance to departments or shops to avoid congestion.

1. ATTENDANCE TIME FOR PAY HOURS

The methods which may be used are :

- (a) Card Time Recorders, of which there are several varieties.
- (b) Key Recorders, using rolls of paper in a clock.
- (c) Dial Recorders, which record the numbers and times of the workers in various ways.

(a) **Card Time Recorders.**—These give a weekly printed and tabulated record of the arrival and departure of employees, on a single card for each person. Some models give the times of incomings and outgoings in one colour printing only, others print automatically the time of all late arrivals, early departures, or overtime workers in red, so that irregular time is brought prominently to notice at a glance. This has an advantage in that short time and overtime can be easily dealt with by the time clerks when making up records for the pay roll, and, further, has the effect of reducing the numbers of late-comers—as it is found that employees avoid red (late) records.

Racks are installed near the recorder, and cards bearing the workers' numbers are placed each week, in numbered pockets in these racks. On entering, the card is taken by the worker from the rack nearest the entrance and inserted in the recorder which prints the time on the card, but in some models a lever has to be depressed before a record can be obtained. The card is then placed by the worker in the "IN" rack on the other side of the machine. The reverse process is carried out when a worker leaves the factory. Absentees can be noted by a glance at the "OUT" rack.

The machines print the day of the week, hour and minute a.m. and p.m. Some models print the month and date in addition. When red printing is used to indicate late-comers and overtime, the clock automatically makes the necessary change over at the scheduled times.

FIG. 15.

No. 4829

No. 37

Name J. Meason

Week ending 8/7 19

INTERNATIONAL TIME RECORDING CO. LTD.

	MORNING		AFTERNOON		EVENING		TOTAL
	IN	OUT	IN	OUT	IN	OUT	
	Σ 8 00	Σ 12 00	Σ 1 00	Σ 5 00			
MON	8 00	12 02	1 00	5 33			
TUE	8 00	12 02	1 00	5 31			
WED	7 59	12 01	1 00	5 31			
THUR	7 57	12 00	1 00	5 32	6 00	8 30	
FRI	8 10	12 02	1 00	5 30			
SAT	8 00	12 00					
SUN							
ORDINARY TIME ...	...	...	Hours	Rate	£	s.	d.
OVERTIME ...	...	...	45 $\frac{3}{4}$	2.2 $\frac{1}{2}$	5	1	2
			2 $\frac{1}{2}$	2.9		6	10 $\frac{1}{2}$
LESS NATIONAL INSURANCE ...			1	11	5	8	0 $\frac{1}{2}$
OTHER DEDUCTIONS ...			11	0		12	11
NET WAGES					4	15	1 $\frac{1}{2}$

Facsimile present-day form of time card with registrations for each day on one line, p.m. registrations indicated by a dash under the hour figure, lost time and overtime automatically printed by the machine in red, thus distinguishing from ordinary time in blue.

Card Time Recorders for gate times are of two kinds :

(1) Those in which the registrations are controlled vertically by a card step in the machine, which automatically rises each day so that the times are printed in the proper space. ("Gledhill-Brook" Models A. and B., and "International." See Figs. 15 and 17.)

The horizontal location—*i.e.* "In" or "Out", in the fully-automatic models—is made at pre-determined times without any manual operation. Other models necessitate the hand movement of a shift lever, which may, if necessary, be locked in position.

(2) Those in which registrations are controlled vertically by the automatic cutting off of a portion of the edge of the card as the time is registered. Each notch cut out is a little more than type depth, so that the times are recorded in the correct vertical position. ("Gledhill-Brook" Models C. and F. C. See Fig. 16.) Here again the setting to the correct column horizontally can be manually operated, or be fully automatic.

In Fig. 16 it will be seen that all one day's time is grouped in one column, the next day's times being staggered in the second column, and so on. Fig. 18 shows another type of card with vertical positions of registrations obtained without any cutting of the card.

Calculation of Attendance Time on the Cards.—This can be made in two ways :

1. By extending the hours daily and totalling at the week-end.

2. By printing on every card the standard weekly total hours (see Fig. 17), to which any overtime is added, and any lost time deducted. By using the two-colour printing mechanism, red being used for lost time and overtime, there is no calculation necessary where the full week's record is printed in blue, which indicates normal hours. This is the speediest method of compiling gate times. It will be seen on reference to Fig. 17 that pay stubs can be incorporated with the time card, and detached at the end of the week for issue to the workers.

The hours recorded are totalled, and shown at the foot of the card. For this purpose, overtime hours are counted as $1\frac{1}{4}$, $1\frac{1}{2}$, or double-time, as the case may be, and then the pay at the worker's rate is entered, the National Insurance and other deductions including P.A.Y.E. are made and the Pay Roll, or Wages Book, is entered up, from which the wages are put up for payment.

PAY CHECK.

Week Ended 9 : 4 : ..

321 GLEDHILL BROOK.

Received Pay.....

Week Ended 9 : 4 : ..

321 GLEDHILL BROOK.

DAY	A.M.		P.M.		OVERTIME		O'TIME	
	IN	OUT	IN	OUT	IN	OUT	HRS.	EXTRA
Su.								
M.	7 55M	12 30Z	1 30Z	5 30Z				
Tu.	7 55Tu	12 30Z	1 30Z	5 30Z				
W.	7 55W	12 30Z	1 30Z	5 30Z	6 00Z	8 00Z	2	1/2
Th.	7 55Th	12 30Z	1 30Z	5 30Z				
F.	7 54F	12 30Z	1 30Z	5 30Z				
Sa.	7 55SA	12 00SA						
					RATE	£	s.	d.
STANDARD					47 - 0			
OVERTIME					2 - 0			
EXTRA					0 - 30			
LOST					49 - 30			
					49 - 30	1/6	3	14 3
DEDUCT					H. 9 U. 10 S.C. 2		1	9
NETT PAY					£	3	12	6

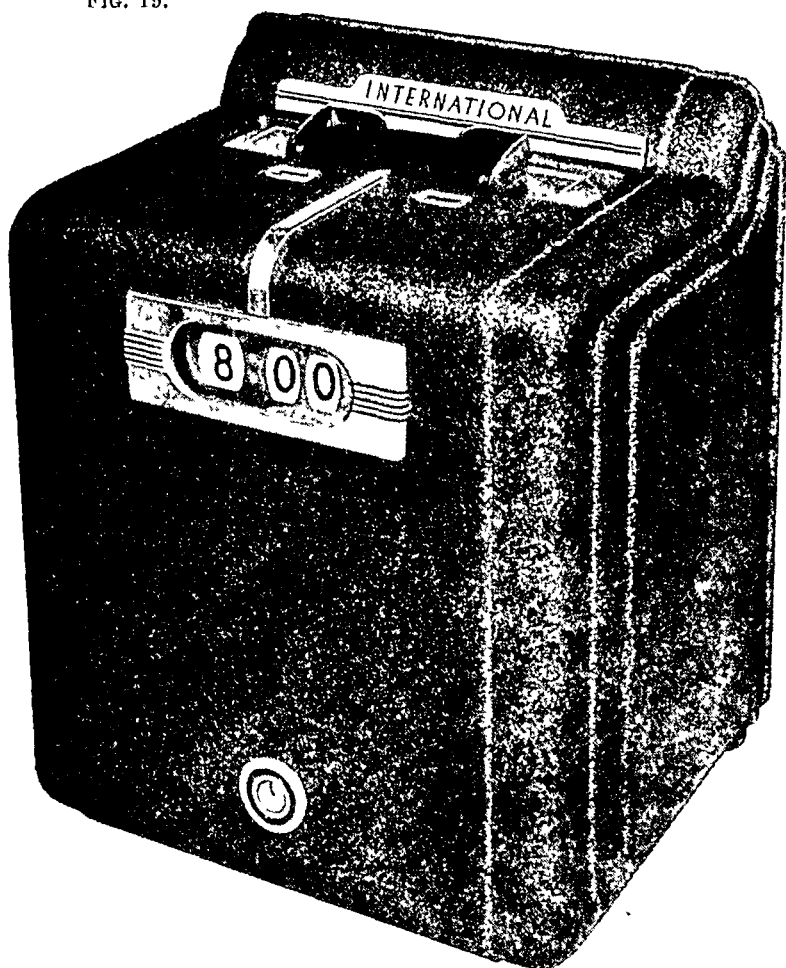
FIG. 18.

No. W 1002									
No. 28									
NAME		<i>R Harrison</i>							
WEEK ENDING		<i>6th March</i> 19.....							
INTERNATIONAL TIME RECORDING CO. LTD.									
	Σ 7 57	Σ 8 01	Σ 8 00	Σ 7 56	Σ 7 59	Σ 8 00			
	Σ 12 01		Σ 12 04		Σ 12 00				
	Σ 1 00	Σ 1 00	Σ 12 59	Σ 1 05	Σ 12 58	Σ 1 01			
		Σ 2 00		Σ 2 00					
	Σ 4 10		Σ 4 02		Σ 4 00				
	Σ 4 31		Σ 4 32		Σ 4 30				
		TU 5 01		TH 4 55					
		Σ 5 29		Σ 5 16					
	Σ 6 16		Σ 6 00		Σ 6 00				
		Σ 7 05		Σ 6 29					
Daily Totals	8 3/4	9 1/2	8 1/2	9 1/4	8 1/2	5	Weekly Totals 49 1/2		
ORDINARY TIME	3	0	7 1/2	LESS NAT. INS.		1	7	NET WAGES	
OVERTIME ...		1	10 1/2	OTHER DEDUC'NS				2	0
GROSS WAGES	3	2	6	TOTAL DEDUC'NS		1	7	3	0 11

Facsimile card slightly reduced, used for recording overlapping times.
(International Time Recorder Models 1102, 8777, and 8877.)

On pay day it is sometimes the practice to hand the completed cards to the workers to check their wages ; or, where a pay stub is provided as in Fig. 17, this portion is detached and used in the same way. After checking the amount, the

FIG. 19.



International Superelectric Card Time Recorder that operates by the mere insertion of the card without movement of levers or handles. For facsimile of records see Figs. 15 and 18.

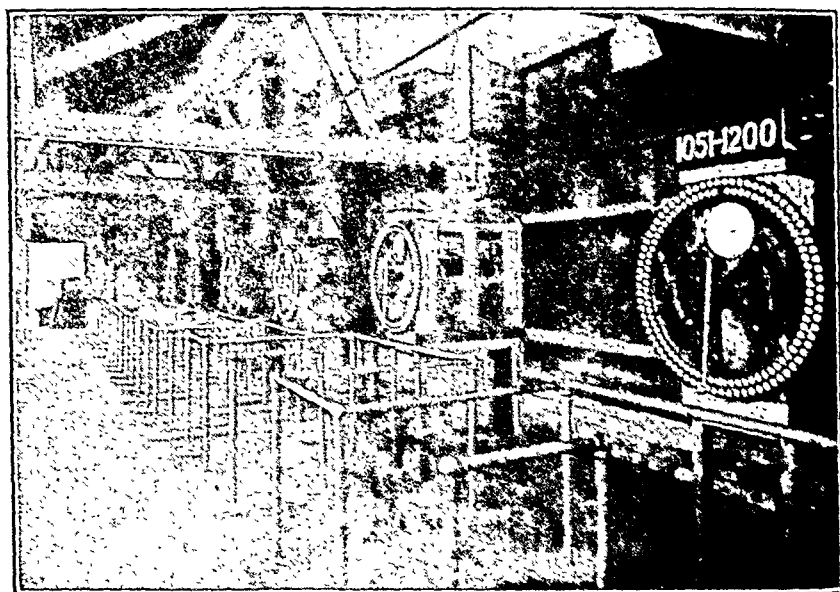
worker signs the card, and, on presenting it to the pay clerk, receives in exchange his pay envelope.

The cards shown in Figs. 15 and 17 are dealt with in the same way, but where there are overlapping comings and goings of employees, as, for instance, in railway depots and large stores, the cards are printed in the forms shown in Figs. 16 and 18, and

Time Recorders taking these forms of card operate without any movement of "In" and "Out" levers, however irregular time schedules may be.

Although spring-wound recorders are still in use, the modern method is to install electrically operated machines. Individual models can be connected to A.C. electricity supply with time-controlled frequencies and they will need no winding or regulating. Where there are a number of recorders, and, perhaps, wall clocks and other time units, the control is centred in a

FIG. 20.



Equipment of International Superautomatic Dial Time Recorders.

Master Clock. Impulses are sent out from this clock every minute or half-minute, and a further check on uniformity of time is provided in the International Superelectric Time System by automatic supervision from the master clock at the 59th minute of each hour. An illustration of a Superelectric Time Recorder is given in Fig. 19.

(b) **Key Recorders.**—The earliest type of time recorder—the Bundy Key Recorder—was operated by the insertion of a numbered key into a key-hole in the front of the machine. The key, on being given a quarter turn, printed the worker's number and the time on a paper strip inside the machine in the order of arrival. The work entailed in transferring these records into a

book or sheet made the system slow and cumbersome, besides leaving the possibility of errors being made. The greater simplicity and flexibility of the card and dial types of time recorders have made Bundy Recorders practically obsolete, although these machines are still in use.

(c) **Dial Recorders.**—These provide a daily or weekly record on sheets. Hours worked may be transcribed direct to the Wages Book, or the sheets filed in a Guard Book, in the form of a Wages Book, with a separate wages summary. Dial Recorders require the worker to press the dial arm into a hole on a dial, each hole bearing a number corresponding to the number of the worker (see Fig. 20). The exact time is recorded against each employee's number on a sheet inside the machine. With the International Superautomatic Dial Recorders, records are automatically tabulated, however irregular the times "In" and "Out" may be. These machines are arranged for 50, 100, or 150 workers; and in this respect are not so elastic as the card recorders, which will allow the addition of time cards as required within reasonable limits.

The numbering on these dial recorders can be arranged according to departments. Weekly sheets may be printed as desired with spaces for "In" and "Out" records, either on daily or weekly sheets, with wages analysis columns exactly as in existing Wages Books, providing for ordinary time, overtime, rate of pay, insurance and P.A.Y.E. deductions, net amount payable, and any further analysis columns desired. No transcribing is necessary if the sheets are filed in a permanent binder to form the wages book (see Fig. 21, which is a reduced facsimile of a section of a sheet containing records made by one of these recorders).

When making up wages from the clocked time-sheets, it is only necessary to deduct lost time from the normal weekly hours, and add overtime, these records being *automatically* printed in red. Blank spaces, of course, indicate absentees.

EXAMINATION QUESTIONS

1. Set out the operations up to and including the preparation of a wages sheet (or pay roll). Draw up specimen forms with typical entries. —*Royal Society of Arts (Advanced)*.

2. State the relative advantages and disadvantages of recording time by :

(a) Recorder clocks.

(b) Depositing and picking up of tickets.

Royal Society of Arts (Advanced).

NAMES		FRIDAY					
Ronalds, Woods	1	757	100	150	230		755 100
James, B. Brooks	2	801	100	150	230		757 100
Frank, Cooke	3	757	100	150	230		800 100
Chas. Lester	4	755	100	200	230		755 100
Frank, Bates	5	800	100	150	230		800 100
Edith, Bishop	6	757	100	150	230		800 100
H. Bradford	7	801	200				800 200
J. Johnson	8	800	200				800 200
W. Emerson	9	755	100	150	230		757 100
Frank, Jensen	10	755	100	150	230		800 100
Dr. Luckette	11	800	100	150	230		755 100
Ruth, Godard	12	757	100	200	230	500 200	800 100
Ed. Gonsky	13	800	100	150	230		755 100
Mr. Moore	14	757	100	200	230		800 100
W. Longbottom	15	755	100	200	230		755 100
Mr. Redcliffe	16	800	100	200	230		755 100
John, Smith	17	755	100	150	230		800 100
H. Thompson	18	200	100				200 1000
Geo. Martin	19	200	100				200 1000
Edith, Clarke	20	757	100	200	230		755 100
David, Gibson	21	755	100	200	230		800 100
Oliver, Black	22	757	100	150	230	500 200	800 100
John, Hutchins	23	757	100	200	230		755 100
John, Hall	24	800	100	150	230		757 100
Ronalds, Young	25	755	100	150	230		800 100
J. H. Wallace	26	800	100	200	230		800 100
Brown, Link	27	755	100	150	230		800 200
Hot. Hensley	28	800	100	150	230		755 100
Tim, Jones	29	800	100	150	230		757 100
Joe, Johnson	30	757	100	200	230		800 100

Employee's Name

Time Leaving (Note irregular times of Nos. 7, 9, 21 and 23, representing Shift Workers)

See—(1) Formulae used relative reduced from International Civil Super-Automatic Time appear in red on the actual report
 (2) Additional columns for other deductions may be introduced as required, etc.

LABOUR : TIME-KEEPING AND TIME-BOOKING 77

Week Ending <i>9th June</i> 19 .. THURSDAY	Ord Time	Over time	Pay On	Rate	£	s.	d.	Less Ins.	£	s.	d.	
158 530	47		47	1/4	3	2	8	1/4	3	1	4	1
159 531	48		48	1/4	3	4	.	1/4	3	2	8	2
158 530	48		48	1/6	3	12	.	1/4	3	10	8	3
202 531	48		48	1/4	3	4	.	1/4	3	2	8	4
158 530	48		48	1/4	3	4	.	1/4	3	2	8	5
158 531	48		48	1/6	3	12	.	1/4	3	10	8	6
	48		48	1/4	3	4	.	1/4	3	2	8	7
	48		48	1/2	2	16	.	1/3	2	14	9	8
200 531	48		48	1/4	3	4	.	1/4	3	2	8	9
159 532	48		48	1/4	3	4	.	1/4	3	2	8	10
200 530	47 1/2		47 1/2	1/8	3	19	2	1/4	3	17	10	11
159 530 559 801	48	6	55 1/2	2/	5	11	.	1/4	5	9	6	12
200 532	48		48	1/8	4	.	.	1/4	3	18	8	13
158 530	48		48	1/6	3	12	.	1/4	3	10	8	14
200 530	48		48	1/4	3	4	.	1/4	3	2	8	15
200 532	48		48	1/4	3	4	.	1/4	3	2	8	16
200 532	48		48	1/6	3	12	.	1/4	3	10	8	17
	48		48	1/8	4	.	.	1/4	3	18	8	18
	48		48	1/10	4	8	.	1/4	4	6	8	19
200 532	48		48	1/10	4	8	.	1/4	4	6	8	20
200 532	48		48	1/4	3	4	.	1/4	3	2	8	21
158 532 600 801	48	6	55 1/2	1/4	3	14	.	1/4	3	12	8	22
159 530	48		48	1/6	3	12	.	1/4	3	10	8	23
200 500	47 1/2		47 1/2	1/4	3	3	4	1/4	3	2	.	24
159 530	48		48	1/4	3	4	.	1/4	3	2	8	25
200 530	47		47	1/2	2	14	10	1/3	2	13	7	26
200 531	47		47	1/4	3	2	8	1/4	3	1	4	27
158 530	48		48	1/4	3	4	.	1/4	3	2	8	28
159 531	48		48	1/2	2	16	.	1/3	2	14	9	29
	47 1/2		47 1/2	1/6	2	11	11 1/2	1/4	2	10	3 1/2	30

↑
Actual
Overtime
worked.

↑
Overtime
is reckoned
as time and
a quarter.

↑
Gross Wages.

↑
Insurance
deduc-
tions.

↑
Net amount
to pay.

↑
Employees'
Eos.

Recorder. (Weekly Model.) The records slightly thicker than the rest in the above illustration to indicate lost time and overtime.
for P.A.Y.E., Savings, etc.

CHAPTER VII

TIME-BOOKING METHODS

IN addition to registering workers' time of arrival and departure it is necessary, in most instances, to record also particulars of work done, and the time spent on each order. There are several methods of obtaining this information, the principal being :

- (a) Weekly Time-sheets.
- (b) Daily Time-sheets or Reports.
- (c) Job-tickets or Job-cards filled in by hand.
- (d) Job Time-recording Instruments.

In some old-fashioned workshops job times are still taken by the crude method of chalking them on a board each day !

(a) **Weekly Time-sheets.**—The workers are required to fill in particulars of the time spent on each job every day. The method is not one giving precision, as the workers are inclined to enter only approximate times, and instead of entering the particulars as each job is done, or at the end of each day, they may even complete the time-sheet at the end of the week, if supervision is not strict.

— A typical weekly time-sheet is shown in Fig. 22.

(b) **Daily Time-sheets.**—These have nearly the same shortcomings as the Weekly Time-sheets. It will be seen from the example (Fig. 23) that provision is made for recording the time spent on each job done during the day, but, although the form is signed by the foreman, there is a tendency for the times to be approximate only. If a strict foreman is in charge, greater accuracy may be obtained by having the job times entered on the forms in the foreman's office, but even with this arrangement idle or waste time is likely to be concealed. The method is convenient and suitable for some classes of work.

(c) **Job-tickets or Job-cards.**—The use of these for registering the time worked on each job or order is extensive. There is a great variety of forms, as nearly every manufacturer draws up his job-tickets to suit his own particular needs.

The usual procedure is for the tickets to be issued to the

entered on the ticket (see Fig. 24) by the foreman, or by the workers, but this means that only one ticket can be issued at a time to each worker. The time may be inserted by use of a special time-recording clock as described on another page.

When there are a number of operations in sequence, a job-card showing each operation may travel with the work through the various shops.

FIG. 24.

JOB-TICKET

Department :		Job No. :				
Works Order No. :		Date :				
Drawing No. :		Time started :				
Operation No. : .....		.. finished :			
Machine No. :		Hours on Job :				
Time allowance :						
Description of Job.		Hours.	Rate.	£	s.	d
Worker's No. : Signature :		Certified (foreman or inspection) :		Office ref. :		

It is desirable that arrangements be made for recording, separately, idle or waste time, and for reconciling the gate times with the job times, unless the system used provides for a different check.

In some factories, where a large volume of detail has to be dealt with, mechanical sorting and tabulating machines, such as the Hollerith or Powers, are used, and it is convenient for the job-cards to be drawn up in a suitable form for the punching required for the purposes of the machine. The specimens shown in Figs. 25 and 26 are typical of Gledhill-Brook clock-cards for use with a Powers tabulator. They combine particulars of piece-work on one side, and on the other side the usual clock times.

The use of tabulating and sorting machines is described in a later chapter.

(d) **Job Time-recording Instruments.**—In many factories time-recording clocks are used for ascertaining the time spent

FIG. 25.

P. 1735 POWERS ACCOUNTING MACHINES														
ORDER NO.														
PATTERN NO.					WORKERS NO.					STAMPOUT				
STAMP IN					STAMP OUT					ORDER NO.				
WHEN YOU COMMENCE A JOB					WHEN YOU FINISH A JOB					UP				
PIECE WORK THIS SIDE OUT														
NO. OFF														
DETAIL														
EXTRA TIME — REASON														
RATE FIXED														
INSPECTOR														
TIME WORKED														
BONUS EARNED														
TOTAL EARNINGS														
TIME ALLOWED														
EXTRA TIME ALLOWED														
CURRENT														
WEEKS TIME														
TIME BROUGHT FORWARD														
TOTAL TIME														
TIME SAVED														
TOTAL TIME														
RATE														
TOTAL														
MACHINE														
MACHINE NO.														
WAGES														
M/C COST														

on each job or operation. There are several types of these recorders, which may be used by the workers themselves, or by the foreman or his clerk. The latter is the procedure when the workmen are not allowed by the rules of their trade union, as in the printing trade, to record such times mechanically.

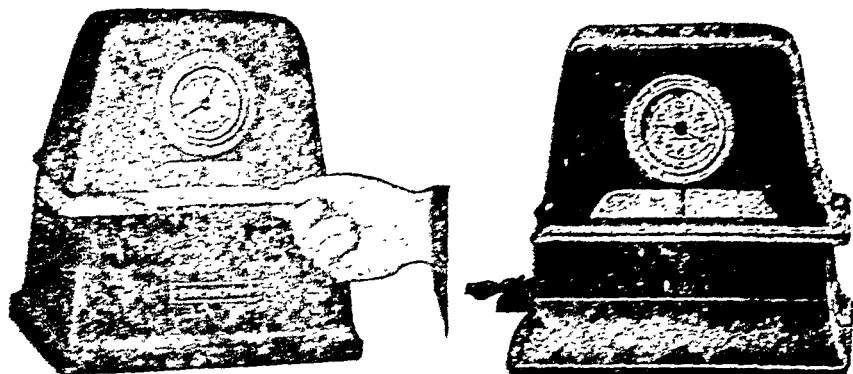
A very adaptable instrument is the International Job Time-recorder, which prints on the job-cards the time of starting and stopping on every job or operation, and with which any size, style, thickness, or shape of card or sheet may be used.

This machine, to-day, is generally an electric model, but illustrated in Figs. 27, 28, and 31 are both electric and spring-wound machines. Where a number are in use in various shops

it is usual to install a master clock to control all the time units, but individual electric models may be connected to the Mains

which he clocks the time of starting and finishing each job or operation. The times are extended into appropriate columns by the Wages Section of the Cost Office, and transferred to a summary sheet. Fig. 29 illustrates a clock-card used in this manner.

(2) *A Separate Card per Job.*—If the jobs are too many to deal with as in (1) above a separate clock-card for each may be used.



instead of at the main gate. This eliminates waste of time by the men on the way to the shops after clocking. In these circumstances, the same clock can then be used in suitable circumstances for timing job-cards as well. In the latter case, the clock and racks should be placed near the foreman's office or desk, which

Fig. 29.

I. T. R. Co. Ltd.		FORM No. L.S. 1930	
DAILY COST CARD			
No. 21		DATE 21/5/...	
NAME James H. Korten			
JOB No.	Time	Time Record	
411	OFF	1 11	9 11
	ON		8 00
328	OFF	1 19.	10 34
	ON		9 15
1098.	OFF	1. 25.	12 01
	ON		10 36
756 ²	OFF	2-23.	3 21
	ON		12 58
1138.	OFF	1. 25.	3 53
	ON		3 28
521.	OFF	1. 32.	5 31
	ON		3 59
	OFF		
	ON		
	OFF		
	ON		
	OFF		
	ON		

International System

Daily Cost Card showing registrations printed by International Time Recorder Model 1008. (Reduced facsimile.)

is usually in a central position in the shop. A useful arrangement, suggested by International Time Recording Co., Ltd., is shown in Fig. 31.

The two card-racks at the extreme right and left of the clock are for gate-time or wage-cards, and the rack between the clock and the "In" rack is for "Jobs in Operation." The one between the clock and the "Out" rack is for "Jobs Ahead." The foreman will also keep a file for job-cards made

Piece-work Tickets.—Payment may be made according to the number of articles or quantity of output produced. In some factories, time is not recorded, in others it is as it should be. When a premium or bonus is paid for time saved, then both quantities and time must be recorded.

A form of piece-work ticket is shown in Fig. 32. Other examples made in the form of a clock-card for use with tabulating machines are shown in Figs. 25 and 26. The number or quantity produced is entered and signed for by the workers

FIG. 32.

PIECE-WORK ORDER.				No.:		
Worker's Name :				Date :		
Clock No. :				Time Taken :		
Part :				Price :		
Operation :				Quantity :		
No. Made.	Passed.	Rejected.	Rate.	£	s.	d.
Signed Worker :			Signed Inspection : Foreman :			

on the ticket or slip. When the work has been inspected, the ticket is countersigned by the person inspecting, or the foreman, and passed to the Office, where the prices are entered and extended. From these the pay-roll is entered, and the necessary details extracted for the Cost Accounts.

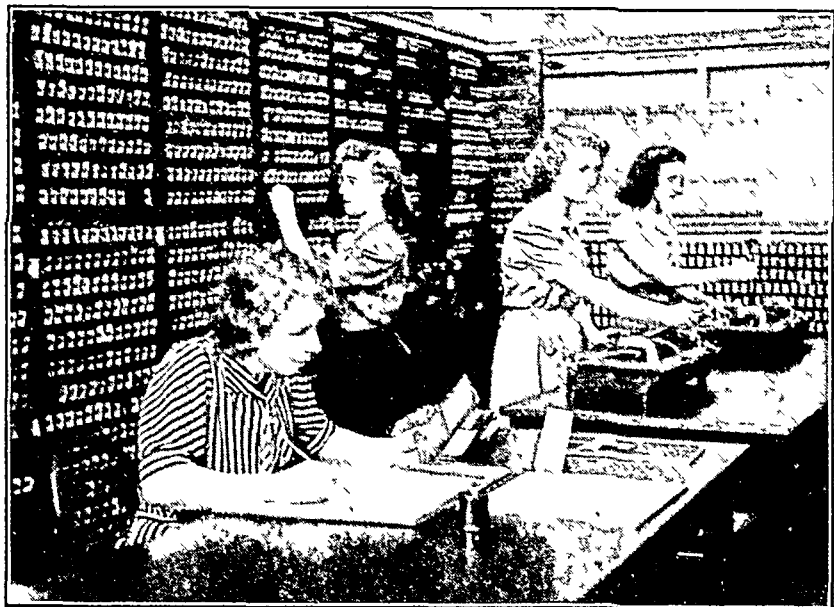
The Ticketograph Coupon System for Control of Piece-work.—The ticketograph is constructed for controlling costs and progress in a factory, whether the work is on a time or piece-work basis. It is not widely used, but is efficient when many minor piece-work operations have to be controlled. The appliance is shown in use in Fig. 33. It imprints a ticket, composed of coupons, one coupon for each operation forming a part of any particular job. (See Figs. 34 and 35.) Each coupon carries the order and style number, quantity, cost of the operation it covers, or any other information desired, for

the purpose of controlling cost. One to eighty-two coupons may be imprinted at a time.

The complete ticket, with the coupons, travels through the factory, attached to the article. As each worker completes his individual operation, he removes the coupon bearing his operation name. This is continued until the article is entirely finished.

Each productive worker is supplied with a coupon holder

FIG. 33.



International Ticketograph installation in use, showing production control board and Ticketograph machine for imprinting information on job tickets.

book, and after he removes the coupon covering his operation, which is his *voucher for pay*, he places it in this book. At the end of the pay period he turns in his coupon-holder book the coupons in which have been automatically counted. This will show what he actually earned, and also eliminates the checking afterwards, as the entire ticket is automatically checked when issued by the ticketograph.

The card of coupons and prices is printed for each particular job as needed. Those operations not required are cancelled, whilst the others are simultaneously priced, before the job goes into the factory.

For progress purposes the ticketograph also imprints on

a portion of the coupon card progress coupons for each department which bear the job No., etc., and date by which the work must be finished. This ticket accompanies the article through the various departments, and as the work is finished in a department the coupon belonging to that department is detached and immediately sent to the office, where it is placed with the counter-

FIG. 34.

1	G	3	F	5	E	7	D	9	C	11	R	OFFICE REF.	A	OVERLOCK	J	ISSUE
												Serial No. U.T. Spl. Quan. Size				
Cutting 1	L'Stitch 3	Tabbing 5		Finish and Exam. 7		Press 9		Special 11						PROGRESS		PROGRESS
Cutting	L'Stitch	Tabbing		Finish and Exam.		Press		Special								
WORKERS, before detaching Coupons, must place their Clock No. in the square corresponding to their operation. Remember—the Coupon is your Voucher for pay.																
INTERNATIONAL TICKETOGRAPH SYSTEM—FORM NO. 2T-14-2253 M																
2	4	6	8	10	12											
Rib and Strap Cut 2	Overlock 4	U's Seam Covering 6	Mending 8	Folding and Parcel 10	Special 12							ALL PRICES PER DOZEN				
												Order No. Call No. Colour Qual.		FINISH AND EXAM	4	CUTTING
Rib and Strap Cut	Overlock	U's Seam Covering	Mending	Folding and Parcel	Special									PROGRESS		PROGRESS

International Ticketograph Production Card. (Reduced facsimile.)

part stub or master-ticket, thereby enabling the production manager to see at a glance exactly where a job is and its state of progress.

A second specimen, showing the Progress portions, is shown in Fig. 35. The references on this example are :

- | | |
|--------------------------|----------------------------|
| A = operation No. | F = name of operation. |
| B = order No. | G = blank squares in which |
| C = style No. | worker inserts his number |
| D = quantity to be made. | on finishing operation. |
| E = price per operation. | |

[illegible]

N.B.—The figures in dark type are printed a line at a time by the Ticketograph by one pressure of a lever; for explanation of see p. 90. The capital letters on the left are not part of the card, but are inserted for reference purposes in the explanation of the card. Average size about $10'' \times 5\frac{1}{4}''$, but the size depends on the number of operations.

* $\frac{6}{16}$ d. on coupon No. 9 is an "extra" added by a "plussing" device.

* 64d. on coupon No. 9 is an "extra" added by a "plussing" device.

The labour cost of the complete job is known by the symbol designating the price schedule (*e.g.* D.B. on office reference coupon, Fig. 35).

This system not only keeps the office in close touch with the work in the factory, but also provides an incentive to each head of a department to get the work finished and the progress coupon delivered to the office with the utmost dispatch.

This is a very efficient system, which is not so well known as it should be for piece-work involving many minor operations.

Preparation of the Pay-roll or Wages-Sheets.—Whichever method of time-keeping, time-booking, premium bonus, or piece-work recording is adopted, the wages due to the workers are entered up on the Pay-roll, Wages-sheets, or Wages-book, as the case may be. A form of Wages-Sheet is shown in Fig. 36.

In many modern factories the Pay-sheets are typed, extended, totalled, and analysed on specially constructed adding and calculating machines.

One type of International Dial Time-recording Clock prints the daily hours on a sheet which becomes the Pay-roll Sheet at the end of the week (see Fig. 21). The pay rates and totals are entered and extended by hand or by machine.

Where Powers or Hollerith tabulating machines are used the Pay-roll may be printed from punched cards. All the columns are entered up and the necessary totals made and printed by the machine. The same cards can also be used for a labour cost analysis, and other punching may be made for special analyses.

A summary is made of the totals of the wages-sheets, together with an analysis of the amount of each denomination of money required by the cashier for making up the pay-envelopes, and a cheque for the total is drawn accordingly.

The pay-clerks make up the wages due to each worker, the respective amounts being placed in pay-envelopes or tins marked with the workers' numbers. If the number of employees is large, it is advisable to count out the money total for each sheet separately, so that when the pay-envelopes for the workers on a sheet are completed, any error in counting the individual amounts is localised. To make a recount of the whole to discover an error before the time fixed for paying out would be almost impossible, except in the case of a small number of workers.

It is prudent to allot to different clerks, and change about,

WAGES-SHEET OR PAY-ROLL.

(N.B.—A separate sheet to each shop is desirable.)

[illegible]

* Sometimes a column for each day of the week and total are included. For piece-workers the "Hours" column may be used for number of piece units on which the piece-rate is payable.

(10) The foreman, or charge-hand, should be present during the paying-out to see that all the pay-envelopes are distributed, and to identify the recipients.

EXAMINATION QUESTIONS

1. What objections do you have to—

- (a) A time-worker filling in his time sheet;
- (b) A piece-worker returning his production?

How would you recommend that these objections should be overcome?—*Institute of Cost and Works Accountants (Inter.)*.

2. Describe two methods of booking time to jobs and discuss the advantages or disadvantages of each.—*Royal Society of Arts (Advanced)*.

3. A factory is running on operation cards which travel with the work and all time is booked, when completed, on these cards. What means would you suggest to check these times against the employee's weekly time so as to ensure correct balancing?—*Institute of Cost and Works Accountants (Inter.)*.

4. A proposal is being considered to install clocks for stamping the times of commencement and finish of jobs or operations; and you, as Cost Accountant, are asked for your views. What advice would you give and, if favourable, what precautions would you suggest being taken to secure reasonable accuracy in the records?—*Royal Society of Arts (Advanced)*.

5. In a factory a group of millwrights are engaged in the installation and maintenance of plant in a series of independent shops. Sketch out a specimen time sheet showing a number of entries covering work performed.—*Institute of Cost and Works Accountants (Inter.)*.

6. What mechanical appliances can be used in preparing a pay-roll and in handling wages?—*Institute of Cost and Works Accountants (Inter.)*.

7. Discuss the various types of mechanical time recorders, stating which you prefer, and why. Include time in and out of the factory and the daily internal works time records.—*Institute of Cost and Works Accountants (Inter.)*.

8. A factory producing parts in quantities uses job-cards which follow the batches of work as they progress through shops, each operative booking his time on the cards. Some of the batches are in hand for several weeks. How would you ensure that each operative's time in any wage week is satisfactorily balanced?—*Institute of Cost and Works Accountants (Inter.)*.

9. Do you consider it to be essential that piece-workers should record the time taken for each article or batch of articles? If you agree, to what purposes could the time record be put?—*Institute of Cost and Works Accountants (Inter.)*.

10. Describe the routine in the calculation and making up of pay-rolls and refer to any mechanical aids known to you. Describe the nature of the checking system to be employed for the verification of piece-work and time-work wages.—*Institute of Cost and Works Accountants (Inter.)*.

11. Draw up a card to be used for recording piece-work, showing the information that you consider to be essential. State what you assume to be the methods in use of (a) recording attendance, and (b) charging overheads to the products.—*Institute of Cost and Works Accountants (Inter.)*.

12. How would you ensure that no "dummy" workmen are included

CHAPTER VIII

METHODS OF REMUNERATION

General Considerations.—The cost of labour is a factor which requires most careful thought. It provides problems of major importance, and, on the solution of these, the success of any enterprise must largely depend.

Reduction in labour costs is one of the chief objectives of the Production Manager, and much guidance to this end can be secured from a suitably organised costing system. Low wages do not necessarily mean low costs—in fact, it is widely recognised now that efficiently organised factories may pay the highest wages, and yet have the lowest labour costs.

Many schemes for remunerating labour have been devised to secure more efficiency than is usually obtained from the common method of paying by the week, day, or hour, without regard to the amount of work or volume of production. Some systems have failed on account of their complexity, others have been introduced successfully in isolated undertakings only, but several have been used with advantage to both manufacturers and workers. Strikes and agitations have arisen where wages schemes are complex, and not understood by the workers; hence, in promoting a special method of payment, care must be taken to see that it is not only understood, but also appreciated as a reasonable one by the workers.

The nature of the industry and the particular circumstances in each factory must necessarily influence the choice of a system of payment and the considerations which arise are mentioned below.

Factors to be Considered.—(1) *Efficiency in Production.*—When volume of production is the important factor, labour control and remuneration may be devised to this end; but, when output is less important than great care and accuracy, wage payments based on production quantities are undesirable, unless competent inspection is arranged for.

The methods used may be classified as follows :

1. **Time (or Day-rate) Wages** calculated on the basis of the time employed—extra payment being made for overtime.

2. **Wages Paid on Results.**

(a) *Individual.*

(1) Piece-work, of which there are four varieties :

- ✓ (i) Ordinary straight piece-work.
- ✓ (ii) The Balance System.
- ✓ (iii) The Balance and Debt System.
- ✓ (iv) Payment on " Points Values " of output.

✓ (2) Differential Piece-work, in which wages are calculated from piece-rates which vary with the quantity produced and the time taken.

✓ (3) Bonus Schemes.

- (i) Task Bonus or Efficiency Bonus payments based on time taken.
- (ii) Premium Bonus payments, based on a fixed proportion of time saved over time allowed.
- (iii) Differential Bonus System, based on a percentage determined by means of a sliding scale, in which the percentage is larger the more the time is saved.
- (iv) Fixed Bonus System. A stated sum per hour saved is paid.
- (v) Cost Premium Method, based on the saving effected in materials and time.

✓ (b) *Collective.*

(1) Group piece-work contracts.

(2) A bonus, in addition to time wages, which is dependent on the production output of the whole works, separate shops, or departments.

In addition to these methods of remuneration, there are schemes whereby the employees share in a portion of the profits, usually with the object of reducing labour turnover, and payments under such a scheme are conditional upon workers having been with the employer for specified minimum periods.

Time-work or Day-work Method.—The workers are paid by the hour, day, or week without regard to the output of work. It is customary in most industries to pay extra for overtime (e.g. time and a quarter, or after say 2 hours, time and a third,

and time and a half after midnight and Saturday afternoons) and double time for Sunday and holiday work.

A disadvantage of this method is that there is no special inducement to the workers to give more than average effort, or more than sufficient to ensure that their services will be retained. Although there may be, generally, a certain amount of interest in the work, there is, frequently, a tendency to take longer than need be in doing it. Efficient workers receive no more wages than those less capable or less diligent.

Circumstances exist in which time-work wages are particularly advantageous, as, for instance, in the tool-room and pattern-shop. The work there demands very skilled men; there is not much likelihood of jobs recurring, because nearly all are special. Care is more important than speedy work, and inducements for the men to work quickly might lead to greater loss than on time.

Time-work may also be satisfactory in small shops, where supervision can be close; and it is also generally accepted as suitable for general labourers, and other classes of indirect labour, even when schemes of payment by result are adopted for skilled workers.

Many large works operate successfully under this method of day-rate pay, but keen management is essential, and it may be that production costs could be lowered, even in these particular works, by introducing some method of payment offering greater inducements to the workers.

Apart from any loss of output owing to fullest efforts not being given when day-rate wages are paid, there is often much time lost by workers in such ways as: (1) deliberately (or otherwise) refraining from seeking the next job; (2) waiting until the foreman gives further instructions; (3) making a job last longer, to avoid starting another before meal-times, or before the time signals; or, (4) where supervision is not strict, making the work last a long time if there is a shortage of jobs.

Time-work tends to higher production costs, because it does not offer monetary advantage for special effort, thereby failing to secure the maximum output. Supervision, however close, does not, as a rule, result in as high an output as is likely under schemes in which payment is made according to results.

The High-wage Plan.—There are some manufacturers who believe that day-rate wages can be as effective as bonus and piece-work schemes for securing a high state of efficiency, by

paying a wage higher than usual for their locality or for their particular industry, and combining a policy of close management.

The plan may be summarised as follows :

- (1) A high rate of wages is paid.
- (2) Special effort and interest in the work is demanded.
- (3) The high wages offered attract the most experienced and efficient workers, who, eager to retain such remunerative employment, use their best endeavours.
- (4) Standards of efficiency and output are set, which the foremen are required to maintain. Work is set for each man to do, and he must do it.
- (5) The work set is not more than can be accomplished, without undue fatigue, in a day of eight hours. This ensures a contented staff. Overtime work is, generally, not permitted.

The most notable adherent to this plan was Mr. Henry Ford, who published a statement that, throughout the Ford industries in America, the minimum wage paid for an eight-hour day was six dollars, except during a probationary period.. He and many manufacturers have proved that high wages do not necessarily result in high costs, but that many costs are higher than they should be because of low wages which command only the less efficient workers.

PIECE-WORK METHODS OF PAYMENT

Ordinary Piece-work.—The worker is paid a stated fixed price for each unit completed, without regard to the time taken on the work. A modern introduction (of which the Bedeaux System is an example) is the payment of piece-work or bonus on “points” values of production operations. Differential rates, or a bonus, may be paid, having regard to time taken, and these are dealt with later. The unit may be a single article, a series of articles, or an operation.

Piece-workers usually develop a high degree of speed through constant repetition of the same operations, with a result that a high level of output is maintained by industrious workers. The employer enjoys lower costs, as the output is increased, owing to the spread of the fixed overhead expenses over a greater number of units produced. On the other hand, in their endeavours to increase the output, the workers may make the quality of the work a secondary consideration; so that a

strict inspection of the work has to be provided, and this added to the cost.

There is another aspect of the matter, which is not realised by piece-workers. They will, generally, strive to increase their output, but, at times, they may be satisfied to work slower, or absent themselves, believing that it is only they who lose thereby; they overlook the fact that their supervision and other overhead expenses form part of the cost, and that any reduction in output results in some increase in the cost per unit. For this reason piece-workers should, normally, be required to record their gate-time in the same way as day-rate workers, and also, normally, job-time as well can be required with advantage. In the case of out-workers who are paid piece-rates, loss of time is less important in this respect.

The determination of piece-rates calls for considerable care, because, when a rate has been fixed, and is found to be too high, there is much difficulty in reducing it, without creating dissatisfaction and friction. If, however, it is necessary to reduce a piece-rate, the distrust of the workers can usually be overcome by re-arranging the operations or units, and fixing new rates. The rate-fixer must consider and measure every movement that the worker has to make, and must time the operations with precision. If previous performances are used as a guide, the rate fixed must make sure that the workers have not been slowing down with the object of securing a higher piece-rate.

The basis for piece-rates may be the recognised time-rate for the class of worker (but the basic time-rate is often increased by a quarter or a third), and the estimated number of units which may be expected in a given time. Thus, with an hourly rate of 2s. (1s. 6d. + $\frac{1}{4}$), and an average output of, say, 12 units per hour, the piece-rate would be 2d. per unit; then, if in a day of 8 hours a worker produced 128 units, he would receive £1 1s. 4d., i.e. more than if he were paid by time at 1s. 6d. or 2s. an hour. But if only 80 units were completed in the 8 hours, the worker would receive only 13s. 4d., or 2s. 8d. less than if paid at the rate of 2s. an hour. Usually there is a time basis of payment provided in such cases as failure of plant, materials, etc.

From the employer's point of view, the labour cost per unit is the same, but the total cost, in the second case, would be higher than in the first, because of the incidence of the overhead expenses. The difference in cost may be very consider-

able, seeing that overhead expenses may be as much as 100 per cent. or more on labour wages.

The Balance System.—A worker is employed at a stated rate of wages per hour, and a piece-work price per job is fixed. If his earnings under the piece price are more than his time wages, he is paid this balance. Should the worker produce work which equals or is less than his time-wages, he is paid at his hourly rate for the time worked. As each job is calculated on its own basis, job-time has to be recorded. This system is popular in boat- and ship-building yards.

The Balance and Debt System.—In this probably obsolete method, the total earnings at piece-work prices are counted, and if this total is more than the wages earned at the day-rates, the excess is paid as a balance. If the piece-work wages earned are less than the time-wages, the difference is carried forward against him as a “debt” to be deducted from any subsequent balance in his favour.

This method of payment, mentioned as a matter of record, may be ignored.

Differential Piece-work Rates.

(1) *The Taylor System.*—A scheme to increase the output of the workers was introduced in America by Dr. F. W. Taylor in his treatise on Scientific Management, and is known as the “Taylor System.”

The Taylor system combines the time taken and the quantity of work produced, so that graduated rates are paid. The rates rise as the output in the allotted time increases beyond a stated quantity per hour.

Rate-fixing for this scheme must be on a “scientific” basis, after the manner first described by Dr. Taylor, otherwise unsatisfactory results develop to the loss of either the manufacturer or the workers, according to whether the rates are too high, or too low, respectively. As rate-fixing on these lines applies also to some of the bonus schemes referred to below, a detailed description of it is included at the end of this chapter.

The features of the differential piece-rate system may be summarised thus :

(1) Day wages are not guaranteed.

(2) A standard time for a job is computed by the rate-fixer, and a piece-rate price is fixed.

(3) If the worker does the work in the standard time, he is paid at this rate.

(4) If longer time is taken, payment may be made at ordinary day-rates, or at a lower piece-rate price.

(5) If the job is done in less than the standard time, a higher rate is paid, as, for instance, standard piece-rate, plus $33\frac{1}{3}$ per cent.

(6) An important feature of the method is that inefficiency is penalised, whilst efficient work is adequately rewarded.

Dr. Taylor's scheme has been improved upon, and, whilst it tends to a much larger output, trials are reported to have shown that, in their effort to earn the higher piece-rates, the workmen spoilt a considerable amount of work.

(2) The Merrick Differential or Multiple Piece-Rate Method resembles the Taylor system in that the piece-rate paid is augmented in an increasing ratio as output rises above the standard fixed; it differs by not imposing a penalty for taking longer than standard time.

(3) Emerson's Efficiency System is another American scheme, which combines ordinary fixed day-wages with a differential piece-rate, as follows :

(1) Day-wages are guaranteed.

(2) A volume of output which is regarded as the standard is decided upon from previous output records and test observations. This standard represents 100 per cent.

(3) A bonus on wages is paid to a worker whose output exceeds two-thirds of the standard for any week.

(4) The bonus increases in a stated ratio to the increasing output up to and beyond the standard, *e.g.*

FIG. 37.

STANDARD OUTPUT = 1500 UNITS.

WORKERS' OUTPUT.		Earnings.
Quantity.	Efficiency.	
1. 750	50 per cent.	Below $\frac{2}{3}$ of standard, no bonus, day-wage only.
2. 1350	90 per cent.	Time-wages plus bonus 10 per cent
3. 1500	100 per cent.	" " 20 "
4. 1650	110 per cent.	" " 30 "

Task Bonus Method of Payment.—The best-known example is

the Gantt Task Bonus scheme, in which a job must be completed in not more than the time-allowance set. The main features are :

- (1) Day-wages are guaranteed.
- (2) A definite task is set on which a bonus may be earned if completed within the time allowed.
- (3) The time allowed is arrived at in a similar manner to that used by Taylor.
- (4) The bonus is a fixed percentage on the time taken ; there is no graduated scale as in the case of the premium systems described below.
- (5) If more than the time allowed for the job is taken, day-rate wages are paid without bonus.
- (6) The time and bonus are fixed for each job, and when a job is completed the man goes on with the next. The pay earned thus consists of day-wages plus the sum of any bonuses for which the worker has qualified.
- (7) The foreman receives a bonus if the workers reach the standard of efficiency qualifying for a bonus.

Example : Four men engaged on similar jobs, day-rate wages 1s. 9d. per hour ; bonus $33\frac{1}{3}$ per cent. on time taken, if job is done within 4 hours :

FIG. 38.

Man.	Time Taken.	Earned by Day-rate or Minimum. s. d.	Bonus. s. d.	Equal to Hourly Rate of s. d.
A	5 hrs.	8 9	none	1 9
B	4 hrs.	7 0	2 4	2 4
C	$3\frac{1}{2}$ hrs.	7 0	2 0 $\frac{1}{2}$	2 7
D	3 hrs.	7 0	1 9	2 11

The system demands a careful calculation of the time necessary to do a job, so that the fixed overhead expenses can be taken into consideration to enable the bonus to be fixed so as to warrant paying this bonus if standard time is improved upon.

Premium Bonus Methods of Payment.—The object of making wages dependent on the results achieved by the workers is chiefly to secure a greater output, and to lower the cost of production. The latter is secured when output is increased, because some of the overhead expenses are constant, and the

amount chargeable to each unit of production becomes less as the volume of units made increases.

In piece-work systems, the labour charge in the costs remains constant.

The premium bonus schemes introduce a different principle. They are a combination of ordinary day-rate and piece-rate methods, but the bonus, or premium, is dealt with in terms of hours saved. The principle followed is that as the efficiency of organisation and equipment provided by the employer adds to the special efforts made by the workers, the benefit of any gain in output should be shared by the employer and the workers. The workers are offered an incentive to give their best efforts, and their interests are adequately protected; it is, likewise, advantageous to the employer to provide efficient plant, and a sound organisation, to ensure the maximum production.

The various premium bonus systems described differ chiefly in the method of calculating the bonus, and the proportions in which any saving is shared between worker and employer.

Like all methods of payment by results, the rate of pay, and, particularly, the rate of bonus, or premium, must be decided with extreme care by the management, bearing in mind that :

(1) If the terms are too liberal, there may be a loss rather than a gain to the business.

(2) If the terms are too low, the desired extra effort from the workers will not be secured, and the probability of friction and discontent arises.

For these reasons, the premiums depend on times of average workers and rates scientifically fixed on the lines described at the end of this Chapter. It is highly probable that unreliable rate-fixing is responsible for the limited use which has been made of premium bonus schemes.

The attitude of the workers and their trade unions is more favourable to ordinary piece-work than to premium bonus schemes, probably on the assumption that the worker receives the full advantage of extra effort, and need only work to the extent to which he feels inclined. The scheme must be equitable to retain a contented efficient staff. An essential requirement under the premium bonus schemes is that there must be a continuing supply of work so that jobs may be proceeded with in close succession throughout the hours the factory is open. Again, the more rapidly a job is completed the greater the average hourly rate earned by the workers, although the total amount

paid per job decreases ; thus the employer also secures reward for the efficiency of his organisation, which contributes, to an important extent, to the workers' ability to increase their output.

The Halsey Premium Bonus Scheme.—This American system originated by F. A. Halsey gives the worker a bonus of 50 per cent. of the time saved over the time allowed for a job. The procedure is described in the next paragraph.

The Halsey-Weir Premium Bonus Scheme.—This differs from the preceding one in that only 30 per cent. of the time saved is given as a premium to the worker.

The procedure for determining the premium bonus for both these schemes is briefly this :

(1) The job is carefully timed by making a time study of every movement and operation, supplemented by information provided by records of previous experience.

(2) To this estimated time is added a percentage which will give the worker a bonus of (for Halsey Scheme) say, $33\frac{1}{3}$ per cent., so that he can earn time and one-third, *i.e.* 50 per cent. of time saved, if the job is completed in the estimated time. This means that $66\frac{2}{3}$ per cent. has to be added to the estimated element time.

Example (Halsey Scheme) :

Estimated time	3 hours
add $66\frac{2}{3}$ per cent.	2 ,,
	—
Job-time allowed	5 ,,

If the worker does the job in the 5 hours allowed, he receives no premium, being paid at his ordinary day-rate. If he takes 4 hours, thereby saving 1 hour, he gets a bonus of $\frac{1}{2}$ hour, *i.e.* $4\frac{1}{2}$ hours' pay at his day-rate for 4 hours' work. He will earn full bonus if he does the job in 3 hours, the estimated time, as he receives 1 hour premium, *i.e.* 4 hours' pay for 3 hours' work. The bonus is thus 50 per cent. at his day-rate per hour on time saved equivalent to $33\frac{1}{3}$ per cent. increase on *his pay* calculated at normal day-rate.

It should be noticed that :

(1) The worker has a guaranteed fixed hourly rate, even if he cannot do the work in less than the time allotted.

(2) The ratio of extra pay decreases when the allotted time is exceeded ; but increases steadily to the extent that

Example (Rowan Scheme):

Ordinary time-rate 1s. 6d. per hour.

Estimated time 3 hours for a job
add $66\frac{2}{3}$ per cent. 2 „

Time allowed 5 „

Job done in 3 hrs. 20 min.

Then the time saved is 1 hr. 40 min. and the premium is
 $\frac{5 \text{ hrs.} - 3 \text{ hrs. } 20 \text{ min.}}{5 \text{ hrs.}} = \frac{100 \text{ min.}}{300 \text{ min.}} = \frac{1}{3}$ or $33\frac{1}{3}$ per cent. and the
rate of pay will be 1s. 6d. plus $\frac{1}{3} = 2$ s. and the wages for the job,
therefore, 6s. 8d.

The formula for the bonus percentage is :

$$\frac{\text{Time Allowed} - \text{Time Taken}}{\text{Time Allowed}} \times 100$$

The actual total bonus value to be added to wages may be
calculated at once also by the following formula :

$$\frac{\text{Time Saved} \times \text{Time Worked} \times \text{Time Rate}}{\text{Time Allowed}}$$

e.g. using the previous example :

$$\text{Total Bonus} = \frac{1 \text{ hr. } 40 \text{ min.} \times 3 \text{ hr. } 20 \text{ min.} \times 18d.}{5 \text{ hrs.}} = 20d.$$

$$\begin{aligned} \text{Amount earned is } 3\frac{1}{3} \text{ hrs. at } 1\text{s. } 6d. &= 5\text{s.} + 1\text{s. } 8d. \\ &= 6\text{s. } 8d. \end{aligned}$$

The following comparative table, using the same figures as
for the Halsey illustrations (p. 108), shows how the Rowan method
differs in results :

FIG. 40.

THE ROWAN PREMIUM BONUS SCHEME

Workman.	Time Estimated.	Time-Rate Allowed.	Time Actually Taken.	Saving over Time Allowed.	Representing Percentage Bonus on Wages.	Ordinary Day- rate Wages at 1s. 6d. per Hour.	Total Wage + Bonus for Job.	Rate per Hour after Bonus Added.
	Hrs.	Hrs.	Hrs.	Hrs.		£ s. d.	£ s. d.	s. d.
A	9	15	15	nil	nil	1 2 6	1 2 6	1 6
B	9	15	9	6	40	13 6	18 11	12 12
C	9	15	10	5	$33\frac{1}{3}$	15 0	1 0 0	12 0
D	9	15	8	7	$46\frac{2}{3}$	12 0	17 7	12 12
E	9	15	$7\frac{1}{2}$	$7\frac{1}{2}$	50	11 3	16 10 12	12 3

Notice that both systems give a bonus of 50 per cent. when the time allowed is halved; also that, although each of the men B to E receives a lower total wage per job, they do more jobs in a week than A, so that they earn considerably more total wages, as evidenced by the higher hourly rates.

From the employer's point of view, the method is safer than the Halsey-Weir scheme, in that the premium being proportionate to the time saved, the risks from mistakes in rate-fixing are less serious. The worker finds it advantageous to save time up to 50 per cent., but, after this, his increase in wages is at a diminishing rate, whereas, under the Halsey-Weir system, it is progressive, and increases substantially.

A bonus of 100 per cent., or double wages, cannot be earned under the Rowan scheme.

The premium bonus schemes which have been devised have, usually, been the outcome of wage-incentive experiments in particular factories, hence, from time to time, different industrialists have published such schemes when they have been tested, and most of them are of American origin.

The Differential Bonus System is a variation of the premium bonus system. The bonus percentage is determined on a sliding-scale basis, and increases the more time is saved. The result is that the quicker workers receive a larger bonus, showing also a greater percentage reward, and yet reduced costs are obtained.

The Fixed Bonus System.—A separate fixed bonus per hour is arranged for each section of the works, e.g. 4d. per hour in shop A, 6d. in shop B. The bonus, at the applicable rate, is paid on the number of hours saved on the standard time allowance. The time allowance is made for each job, and represents the time which would be taken by the average worker on day-rate wages.

Cost Premium Method of Payment by Results.—This is a method which may be used in connection with standard costs, but only to a limited extent, in view of the fact that materials as well as time are taken into account. [The principle followed is to determine the standard cost of materials, labour, and expenses—a bonus being given if the actual cost is less than the standard. The assumption is that the workers can reduce costs by saving time, and by exercising care with materials, so that waste is eliminated as far as possible; a proportion of the saving so effected is distributed to the workers on some agreed basis.

Rate-fixing by Time Study Methods.—This is commonly called “scientific rate-fixing,” following the lead given by Dr. F. W. Taylor. In the payment of work on “Points Values,” the points are often based on this method.

The time taken to do a job on a machine tool is considered in three sections :

- (1) The time taken in reading the drawing and instructions, and the handling of the tools to be used in the machine.
- (2) The time setting the tools and handling the machine.
- (3) The element time for the actual operations, when running.

The first two are timed in minutes, and this time is added to the running time necessary for the number of units, or pieces, which have to be made. The time for each operation when the machine is running is taken with a stop-watch, and is called the element time. To the total element time, an allowance for contingencies is added; this contingency allowance may be 20 per cent. or more, according to the type of machine.

The sum of these times represents the “estimated time” per article made. To this $66\frac{2}{3}$ per cent. is added to allow of a bonus of $33\frac{1}{3}$ per cent. This is the “time allowed” or “standard time.”

If the time allowed is taken by the worker, he receives no bonus, but is paid at ordinary day-rate. If exactly the estimated time is taken, a bonus of one-third is earned.

The procedure for building up the rate and the application of it is shown in the following simple example :

	Element Time per Unit made in Minutes.	Time for Batch in Minutes.
Read instructions and drawing	—	3.5
Draw tools from store	—	7.0
Fix tool No. 1	—	2.0
Feed material	—	0.5
Turn	0.15	—
Fix tool-box in turret	—	0.5
Set tool	—	6.0
Turn	0.75	—
Set dies	—	5.5
Cut thread	0.20	—
Set parting of tool	—	4.5
Part off	0.50	—
	<hr/>	<hr/>
Total times	1.60	29.5
Contingencies allowance 25 per cent.	0.40	<hr/>
	<hr/>	
Total element (or running) time	<u>2.00</u>	

- (iv) Thereby to secure more economical production, and a high output.

The defects of these collective incentive schemes (except when applied to small groups) are :

- (i) The amount received by individuals is usually too small when the bonus is shared by all employees.
- (ii) The less industrious and slow workers share equally with the willing, efficient ones.
- (iii) In the majority of schemes the intervals between bonus distributions is too long to retain sustained effort.

Examples of Collective Bonus and Profit-sharing Schemes.

(a) *Priestman's Production Bonus*.—A standard weekly production output is decided upon, and valued in units or points for each class of manufacture, and should the output in any week be above this standard, a bonus is awarded for distribution to the employees. The actual output each week is valued in points, on the same basis as the standard. The bonus paid is proportionate to any increase. For example, 500 workers in a 48-hours week are set a standard output valued at 60,000 points. One week this year there are 600 workers, from whom the production is valued at 72,000 points. No bonus would be payable—there being no increase because both the workers and the output were 20 per cent. more. The next week 500 workers had an output worth 63,000 points—this being 5 per cent. above the standard set, each worker would receive 5 per cent. bonus on his wages. The scheme originated in an Iron Foundry, where tonnage affords an easy measure of output.

(b) *Bonus based on Reduced Production Costs*.—This method depends on a standard cost of materials, day-wages, and such part of the overhead expense as it is possible for the employees to influence as to reduction. When actual cost falls below this standard, part of the saving is set aside as a bonus to the employees. The distribution may be on the basis of wages, and, usually, the rate of bonus is affected by the period of service. This is called the Collective Cost Premium bonus scheme.

(c) *Bonus based on Reduced Labour Costs*.—This is sometimes referred to as the Towne Gain-Sharing System, the method having been introduced by Mr. H. R. Towne. The bonus consists of half of any reduction in the cost of labour as ascertained for a suitable standard output, based on previous results.

The bonus is divided between the foremen and the operatives, as, for instance, 20 per cent. to the foreman, and 80 per cent. to the operatives.

As the bonus is usually paid half-yearly it loses much of its effect as an incentive to individual effort, although the share taken by foremen encourages their co-operation.

(d) *Profit-sharing and Co-partnership*.—There are many forms of these, but, despite efforts to increase their use, official records show that, of the many schemes that have been put into operation, many have been discontinued.

One of the principal purposes of these schemes is to reduce labour turnover.

The trade unions do not favour the principle.

Sometimes the bonus is distributed wholly, or in part, in shares carrying limited rights, and an elected employee may be asked to join the management; in other cases, a small percentage may be paid on wages and salaries, as though they were capital invested, or a sliding scale of bonus may be paid, varying with length of service.

Criticisms which are sometimes advanced by labour officials are that bad management and lack of well-maintained plant reduce the profits, and, therefore, the bonus, whilst the share in the profits allotted to the workers is too small. In some cases there is a certain amount of distrust of the profits declared by the employers. For the purposes of this book it is not necessary to describe the details of any of these schemes.

EXAMINATION QUESTIONS

1. Discuss the relative advantages of a Piece-work System and a Premium Bonus System for the payment of wages.—*Institute of Cost and Works Accountants (Final)*.

2. Describe the Premium Bonus system. What are its advantages and disadvantages respectively to employers and employees?—*London Chamber of Commerce*.

3. When considering the advisability of carrying out a job by piece-work or day work what relevant considerations would you urge for or against either method as affecting the ultimate cost?—*Royal Society of Arts (Advanced)*.

4. Would you adopt a Premium Bonus System, or, alternatively, a straight Piece-work System in the case of:

- (a) The manufacture of small repetitive work;
- (b) Fitting and erecting various classes of large machines;
- (c) Spinning and weaving textile fabrics?

State reasons for your choice of system.—*Institute of Cost and Works Accountants (Inter.)*.

5. What are the objections to straight piece-work as a method of remuneration and what remedies or alternatives would you recommend?—*Institute of Cost and Works Accountants (Inter.)*.

6. Describe briefly three methods of payment by results and indicate in each case the formula by which payment to the employee is computed. State what, in your opinion, are the respective advantages and disadvantages of each.—*Royal Society of Arts (Advanced)*.

7. Your advice is asked as to the advantages and/or disadvantages of the following wages systems, which have been submitted to a manufacturer for the purpose of increasing the output and reducing the cost of production for the mutual benefit of both employer and employee :

(a) Payment to the worker of a fixed premium of one-third of the saving for each hour saved on the standard time for the performance of a job.

(b) Payment to the worker of a premium bearing the same percentage to the wages rate as the time saved bears to the standard time for the performance of a job.

Illustrate your answer with a concrete example.—*Society of Incorporated Accountants and Auditors (Final)*.

8. Under the Weir system of Premium bonus, the employer shares with the worker the time saved. Would you consider this an equitable arrangement? State your reasons.—*Institute of Cost and Works Accountants (Inter.)*.

9. State whether you would prefer the use of payment of wages by piece-work or on time in the following industries :

(a) House Building; (b) Coal Mining; (c) Motor-car Manufacture. Give your reasons.—*Institute of Cost and Works Accountants (Inter.)*.

10. What difficulties would you anticipate in connection with a proposal to clock times of starting and finishing operations on jobs, where payment is made normally by piece-work but with occasional breaks on time-work? How would you propose to overcome these difficulties?—*Institute of Cost and Works Accountants (Inter.)*.

11. In what circumstances, if any, would you advise the payment of wages on the basis of hourly rate? Give reasons.—*Institute of Cost and Works Accountants (Inter.)*.

12. Describe briefly two plans of premium bonus. State which you prefer and your reasons.—*Institute of Cost and Works Accountants (Inter.)*.

13. Sketch out a system of Payment by Results in any trade or industry in which you have experience.—*Institute of Cost and Works Accountants (Inter.)*.

14. What are the general circumstances which render payment by results desirable or undesirable respectively?—*Institute of Cost and Works Accountants (Inter.)*.

15. For a job which can be done in 15 minutes by an average worker, illustrate several different methods of payment by results, and show the cost each for each method when the job is done in 10 minutes.—*Institute of Cost and Works Accountants (Inter.)*.

16. Various methods of remunerating labour have been devised with the object of saving Indirect Charges. Give details of any two methods with which you are familiar and explain the systems necessary to ensure that the labour cost of the output is properly recorded and paid for.—*Society of Incorporated Accountants and Auditors (Inter.)*.

17. In what circumstances would you differentiate, in your costs, between the time taken in (a) making ready or setting up for a job preparatory to the running off on a machine, and (b) running off the job? What objects would you aim at securing by such differentiation?—*Institute of Cost and Works Accountants (Final)*.

18. Detail the various methods of remunerating labour and consider each method from the point of view of costing and its probable influence on output.—*Society of Incorporated Accountants and Auditors (Inter.)*.

19. What do you know of Time and Motion Study?—*Incorporated Accountants (Inter.)*.

20. A worker is remunerated under the Rowan Premium Bonus System with a guaranteed time-rate of 1s. 6d. per hour.

His time-cards for the week ended 5th December, 19.., show :

32 hours on Job No. 82; 6 hours on Job No. 83; 10 hours on Job No. 84.

The times allowed under Rowan Premium Bonus System are :

For Job No. 82, 36 hours; Job No. 83, 5 hours; Job No. 84, 12 hours.

Calculate the wages cost of each job, and state the worker's gross wages for the week.—*Association of Certified and Corporate Accountants (Final)*.

21. In a factory where a system of piece-work is in operation, outline the necessary forms and records. How would you deal in the Cost Accounts with "make-up" wages—that is, those cases where the operators' piece-work earnings are less than the minimum weekly rate?—*Institute of Cost and Works Accountants (Inter.)*.

22. (a) Explain the system of payment of wages (i) on the piece-work system and (ii) on the bonus or premium system, and state in what way they differ from the time system.

(b) Point out any advantages which you think there are in the bonus system.—*Chartered Accountants (Final)*.

23. Name six different methods of computing the wages to be paid to workmen and describe fully two of these methods and state to which industry they are particularly appropriate.—*Institute of Cost and Works Accountants (Inter.)*.

24. What are the advantages, or disadvantages, of the time basis of remunerating labour, and to what extent do you consider the interests of employer and employee are at variance under such a system?—*Institute of Cost and Works Accountants (Inter.)*.

25. A worker under the Halsey method of remuneration has a day rate of 54s. 11d. per week of 47 hours, plus a cost of living bonus of 12s. per week. He is given an 8 hours' task to perform, which he accomplishes in 6 hours. He is allowed 30 per cent. of the time saved as premium bonus. What would be his total hourly rate of earnings?—*Institute of Cost and Works Accountants (Inter.)*.

26. An operative whose basic rate is 52s. per week of 47 hours plus war bonus of 13s. is put on piece-work. From the following differing times on similar jobs, calculate the labour cost in each case :

(a) time allowed 6 hrs., taken 4 hrs.

(b) " 6 hrs., " 6 hrs.

(c) " 6 hrs., " 8 hrs.

Institute of Cost and Works Accountants (Inter.).

CHAPTER IX

OVERHEAD

CLASSIFICATION

✓ It has been mentioned previously that Overhead may be analysed into four groups of expense, viz. Production, Administration, Selling, and Distribution. Manufacturing Overhead expense comprises the production expenses and all administration expenses other than the proportion allocated to selling and distribution. Manufacturing Overhead may be classified into three sections :

1. Indirect material. ✓
2. Indirect labour. ✓
3. Indirect expenses. ✓

These three sections cover all the Overhead chargeable to production up to the time the finished products are placed in the Finished Stock Store, or are ready for despatch.

Fixed and Variable Charges.—In considering the method of accounting for Overhead, it is necessary to separate Fixed Charges and Variable Charges, sometimes referred to as Fixed and Floating Overhead (or Oncost) respectively. ✓

Fixed Charges are expenses that do not vary in total substantially, or at all, with the volume of production, e.g. rent, rates, taxes (Schedule A), insurance, depreciation of plant, machinery, buildings and fixtures, and, if included in cost (which is undesirable), interest on capital values used in the factory. ✓

Variable Charges are expenses that fluctuate in amount from period to period, not necessarily in direct proportion to the volume of production, but largely so, and in sympathy with it, e.g. indirect wages, power, repairs. ✓

There is no hard and fast line between fixed and variable overhead, and for some items the distinction is often entirely dependent upon the *particular conditions* in any given undertaking, and in some factories with well-developed costing and control a separate grouping of “*semi-fixed*” overheads (or *semi-variable*) is introduced.

The Purpose of this Classification into fixed, variable, and

semi-variable groups is most evident when production and sales budgets are operated. The ascertainment of differential or marginal costs for different volumes of production is facilitated. It will be apparent that the cost of fixed and semi-fixed overheads on each unit of output falls as the volume of production increases. When production falls many variable overheads can be reduced, and, to a lesser extent, so can semi-fixed, but not so the fixed overheads.

"Dumping" and "Cut Price" Sales become possible and profitable when the production according to normal programme has been attained, thereby covering all the fixed and variable overheads. The extra work at cut price will not involve any cost for fixed overheads, so that if the price exceeds prime cost plus variable overheads there will be extra profit to that extent. Cheap, "Sale Lines" offered to big stores or other classes of business depend on this principle. So also do cheap "excursion fares" on trains and pleasure boats. All the fixed costs of the permanent assets, signals, lighting, and permanent staff are already absorbed in normal fares; the extra variable expense (*e.g.* fuel, additional staff for the train or boat, advertising and a few sundries) and some profit is all that the fare has to cover.

Reduced prices in time of bad trade has been dealt with on page 3.

Exceptional Expenses or Losses.—Generally these will be treated best by transferring them direct to Profit and Loss Account in order not to disturb the normal comparisons of cost. For example: Loss by damage through flood; removal of plant; abnormal wastage and spoilage of a large quantity of goods through an exceptional mistake; damage by fire not recovered by insurance; etc. Such items are exceptional capital losses, and to include them would obscure actual costs of production and make them of little value for cost control and comparative purposes.

The Object of Classifying Overhead.—The sub-division of Overhead is made to locate responsibility and to enable the management to compare and to control the cost of each group with that for preceding periods, processes, jobs, or units, as well as with the budget, or pre-determined estimated expense costs for the period under review.

The Use of Standing Order Numbers.—To make the classification effective for this purpose, it is necessary to provide a

scheme for the collation and analysis of Overhead, and the headings under which the analysis is made should be clearly defined for everybody in the works who may be concerned. There is often a strict limit as to the amount of time or materials which workers and foremen may charge to an expense standing order number; beyond this limit a manager's counter-signature or authorisation is to be obtained. Such a rule is important to *prevent and control* heavy expenses. Owing to the varying nature of expenses the Standing Order Numbers may be in groups of different limits.

The most usual method is to use a nomenclature of Standing Order Numbers, sometimes called Syllabus Order Numbers, because they are enumerated in a permanent list, or schedule, detailing the items to be included under each heading. Headings of expense are decided upon by the management, and each is given a distinguishing number, which is used to simplify charging, and to permit of easy reference in the accounting. The related types of expense may be numbered in groups, identified by a symbol, or group number, which is quoted with the number; or straight numbering may be used. For example:

Repairs—the numbers might be arranged under the group symbol R, then, say:

R. 11. Repairs to buildings.

R. 20. .. ,, plant.

And, as it is necessary to further identify such expenses, sectionally, the scheme may be extended thus:

R. 11. Repairs to buildings (foundry).

R. 12. .. ,, power-house.

R. 13. .. ,, machine shop.

R. 14. .. ,, office building,
 etc.

R. 21. Repairs to steam plant.

R. 22. .. ,, transmission plant.

R. 23. .. ,, electric power plant,
 etc.

Similarly, other symbols and numbers can be allotted to other items of expense.

If straight numbering is used, the prefix S.O. (Standing Order) may be used for all expense numbers, to keep them dis-

inct from Works Order, Production Order, or Job Order numbers, which are generally used to identify work other than that chargeable as an expense. Standing *Works Order* Numbers are sometimes used in connection with production in some factories, but more usually Standing Order Numbers are employed only to designate *expense* accounts.

Whatever scheme of account numbering is adopted, items can be easily identified with departments by giving each department a number which can be used with the expense numbers, thus : S.O. 50/6 might mean, say, Repairs in shop No. 6.

A Scheme of Standing Order Numbers.—Every factory using expense numbers has its own particular scheme of nomenclature for standing order numbers, compiled to suit the needs of its cost accounting organisation.

Too minute an analysis should be avoided, as excessive detail may encumber supervision, and create clerical work which is more expensive than is commensurate with the advantages secured. As regards the scheme of numbering below, it should be observed that the analysis may be condensed, or expanded, according to the needs of the management.

A scheme of suggested symbols and numbers is given below. These, of course, are quite arbitrary. Instead of a symbol letter numbers are preferred when mechanical sorting and tabulating machines are used. In such cases N2 series (for example) would be referenced as 2.21, 2.22, etc.

Factory Overhead.—*The symbol R.* designates repairs and maintenance.

R. 1 Series (repairs and maintenance of buildings) :

- R. 11. Power-house.
- R. 12. Foundry.
- R. 13. Automatic shop.
- R. 18. Offices,

etc.

R. 2 Series (repairs and maintenance of plant and machinery, including the cost of moving plant and refixing) :

- R. 21. Steam boilers.
- R. 22. Steam pipe-lines.
- R. 23. Milling machines.
- R. 24. Steam press,

etc.

R. 3 Series (repairs to office machines, time-recorders, etc.) :
The symbol W. indicates idle time ; lost time ; overtime ; material loss, waste, etc.

W. 1 Series (waiting and lost time) :

- W. 11. Machinery breakdown.
- W. 12. Waiting instructions.
- W. 13. Waiting for materials.
- W. 14. Expense of idle plant and facilities disused owing to shortage of work. (See pp. 127, 175.)
- W. 15. Other waiting or idle time.
etc.

W. 2 Series (material loss or waste) :

- W. 21. Faulty material.
- W. 22. Rejected articles.
- W. 23. Stores discrepancies.
- W. 24. Scrap collection, recording and disposal,
etc.

W. 3 Series (overtime, holidays, sickness) :
 and so on.

The Symbol S. for shop sundries :

- S. 11. Oiling and cleaning machinery, etc.
- S. 12. Shop cleaning, etc.
- S. 13. Consumable shop stores.
- S. 14. Perishable tools.
etc.

The Symbol T. for indirect labour, etc. :

- T. 1. Stocktaking and stores physical audit.
- T. 2. Inspection and testing. (T. 21, T. 22, etc., for different groups.)
- T. 3. Experimental and research.
- T. 4. Timekeeping and gate control.
- T. 5. Shop clerical work.
- T. 6. Drawing office expenses.

Cost Account Numbers for Other Expenses may be used in the works offices on similar lines to Standing Order Numbers in the factory, as, for example :—

The Symbol A. for administration expenses :

- A. 1. Executive and management salaries.
- A. 2. Office rent, rates, etc.

valent to rent may be made, or sometimes the Schedule A Valuation for Income Tax (Property Tax) is used.

2. Rates imposed by local authorities.

3. Insurance of factory property, machinery, and the fixed annual charge (if any) for automatic fire alarms, sprinkler installation.

4. Depreciation of plant and machinery.

5. Depreciation of buildings.

6. Salaries of managers and principal officials are often included.

7. Interest on capital to the extent (if any) it is included as an item of cost. (See page 144.)

B. Works Overhead (Variable or Floating).

1. Maintenance and repairs (which includes materials and labour used by maintenance service departments plus the overhead apportioned to these departments).

1.01 of Machinery.

1.02 of Buildings, roads, etc.

1.03 of Boilers.

1.04 of Generators.

1.05 of Hydraulic plant.

1.06 of Electric motors and controllers, starters, switches, etc.

1.07 of Lighting equipment, wiring, conduits, switch-boards, etc.; and alarms.

1.08 of Power plant, power-lines.

1.09 of Transmission plant, shafts, pulleys, countershafts, belting.

1.11 of Material transport and handling plant, hoists, cranes, elevators, overhead trolley-lines, belt conveyor systems, trucks, etc.

1.12 of Stores fixtures, bins, scales, etc.

1.13 of Steam plant, compressed-air plant, etc., including pipe-lines.

1.14 of Furnaces.

1.15 of Dies, power-press, and foot-press.

1.16 of Tools for turning, butting, milling, boring; power knives, saws, shears; chucks and tool holders.

1.17 of Office equipment, office machines of all kinds, etc. (Works).

2. Oiling and cleaning machinery, shafting, motors, etc.

3. Miscellaneous operating supplies (consumable stores), *e.g.* cotton waste, cloths for wiping; belt dressing, fasteners, etc.; brushes for sweeping, dusting, scrubbing; oil, benzine, emery and sand paper, carborundum dust; cleaning compounds; lubricating oils, greases; cutting oils and compounds.

4. Perishable tools, small taps, dies, drills, files, emery wheels, polishing wheels, oil stones, saw blades, reamers, etc.

5. Waiting time (= idle time).

5.01. Machinery breakdown.

5.02. Power supply cessation.

5.03. Waiting for work instructions.

5.04. Accident to workers.

5.05. Waiting for material.

5.06. Waiting for tools.

6. Holidays and sickness with pay.

7. Stocktaking and inventory physical check expenses.

8. Inspection and testing.

9. (.01) Experimental and development research work.

(.02) Designing for production. (.03) Drawing office expense.

(.04) Time study, rate-fixing, etc.

10. Timekeeping and gate control.

11. Supervision; foremen, assistants, superintendents; administration.

12. Shop clerical work, labour and supplies of works stationery.

13. Shop labouring, general indirect; shop cleaning, etc.

14. Stores expenses; carriage inwards (sometimes); store-keeper and assistants, and other charges, *e.g.* branding, measuring and cutting off materials for issue; but not expenses particular to a specific order.

15. Training and instructing trainees (wages and materials, less value of productive work).

16. Welfare and recreation; ambulance and first aid; dining facilities; works police.

17. Waste—spoilt and lost materials, stock discrepancies, faulty work; scrap collection and disposal.

18. Insurance, (a) national; (b) compensation; (c) employers' liability; (d) machinery breakdown.

19. Overtime expenses. (See observations below.)

20. Power of all kinds; process fuel.

21. Steam service.
22. Lighting.
23. Heating.
24. Other services, *e.g.* fire protection, internal transport.
25. Transport of materials in the Works.

C. *Administration Overhead (Fixed and Variable).*

1. Salaries of executives, managers, etc.
2. Accounting and clerical expenses.
3. Office rent, rates, insurances. (Excluding those applicable to the Works.)
4. Office lighting, heating, and cleaning.
5. Office repairs and maintenance of buildings.
6. Office repairs of equipment; machines.
7. Stationery, postage, telephones.
8. Legal charges.
9. Financing charges.
10. Investigations.

D. *Selling Overhead (Fixed and Variable).* (See p. 130 for various groupings for control purposes.)

1. Sales office expenses.
2. Travellers' salaries, commissions and expenses; salesmen's training.
3. Advertising; catalogues, price-lists; samples; demonstrators; show-rooms and selling depots.
4. Discounts allowed.
5. Estimating; preparing drawings and designs for tenders.
6. After-sales service.
7. Agents.

E. *Distribution Overhead (Fixed and Variable).*

1. Warehousing and control of finished goods; including insurance premiums.
2. Packing and warehouse trucking.
3. Loading; loading conveyors, charges for cranes, hoists, etc.
4. Delivery—upkeep and running of vehicles; outward freight and carriage, except that charged to customers.

The Distribution of Overhead.—The object of classifying the overhead expenses is to facilitate their correct distribution to various departments, and thence to the cost units of production.

The procedure may be shown in the form of a general plan :

FIG. 41.

1. All overhead expenses are collected under the separate headings of expense (Standing Order Numbers).
2. All these separate totals of expense are apportioned to Production Departments (Shops) and Service Departments.
3. The total of each Service Department is apportioned on a suitable basis in accordance with the services rendered to the Production Departments that use, or are entitled to use, the services.
4. The total Overhead for each Production Department is divided equitably, so that every works order, or cost unit of production, is charged with its share of the expense of each department, or shop, through which it passes.

OBSERVATIONS ON CERTAIN KINDS OF EXPENSE

Works Expenses :

Estimating and Drawing Office Expenses may often be apportionable as between Works and Selling Overhead.

Royalties.—(a) Production. These can often be charged direct instead of in Works overhead expenses. (b) Selling (see p. 129).

Depreciation and Interest.—See next Chapter.

The Cost of Moving and Refixing Plant.—This is a works overhead expense and is so treated on the grounds that the new fixing outlay cannot have a longer life than the machine itself, and is sufficiently represented in capital by the balance of the original fixing charge. The cost of fixing new plant is usually capitalised and written down with the plant itself.

Rent Charge of Premises Owned.—As no rent is payable, it is usual to include some charge in the Overhead. This sometimes takes the form of Schedule "A" tax assessment or an amount equal to interest on the capital value, at a rate agreed by the management. Allowance for such an amount taken into cost must be made when reconciling with the Financial Accounts. When one factory is owned, and another is rented, the course suggested is desirable to secure comparable costs of products in each. This is the same principle as applies when comparing costs of products made by machines of different capital cost.

Inspection.—This is generally a works expense apportioned to the manufacturing processes or operations concerned. It is sometimes the practice, when convenient, to make this a direct

charge to specific jobs. The matter largely depends on the type of product.

Tool-Setting.—If this expense is necessary for a specific order, it may be regarded as a direct charge. When a number of orders can be dealt with on a machine with one setting, the expense is included in the overhead rate for the machine or department concerned.

Wages of Engineers and Millwrights of the Repair Service engaged in repairing machines must be apportioned to departments, or centres, and then to the machines. The cost can thus be included in the machine overhead. Caution is necessary when this staff is engaged on work of a capital nature; their time should then be charged to an appropriate job. Account Numbers for the Capital Accounts concerned only by a manager's authority.

Overtime and Special Night-work Wages.—When overtime or night-work is necessary owing to the special desire of a customer to have the job completed or rushed through within the time specified, the extra payment for overtime is legitimately charged to the job as direct labour.

When, however, the overtime is regular, or intermittent but recurring, and is for the purpose of generally increasing the output of the factory, *e.g.* to keep up with stock requirements or orders generally, the cost of the overtime is charged to Works Overhead Expense Account. A standing order number is provided for this.

Distinction should be made between special intermittent overtime and night-work and that which is regular and budgeted. The latter can be recovered in overhead rates; the former if not chargeable to a particular job, or if not suitable for inclusion in overhead, will be written off to Profit and Loss Account.

Expense of Idle Machines and Facilities.—This, if due to shortage of work, as in a period of trade depression, should be recorded under a Standing Order Number and written off direct to Profit and Loss Account, otherwise idle time is included in overhead. Hence Idle Time and Idle Facilities must not be confused. The position is discussed on pp. 174–175 and 178.

Also, the costs of care and maintenance and insurance of reserve plant, buildings, or land should be excluded from production costs.

Carriage and Cartage Inwards (of Stores Materials).—This is

usually treated as part of the Cost of the materials, and not as Overhead. (Distinguish transport of materials to the works, and internal transport facilities which are items of works overhead.)

Administration, Selling, and Distribution Expenses.—Separate totals of these three groups of expense must be made. Sometimes it is the particular conditions in a given business which decide the heading under which certain items are to be included.

An important aspect of the separate analysis of Factory and other overheads is that Work in Progress has to bear its proportionate charge for expenses applicable to manufacturing, *i.e.* all factory or works expense and a fair apportionment of general management expense, but with strict exclusion of any expense relating to selling and distribution. The latter expenses are applicable only to marketing, and are chargeable therefore against sales of finished products. The marketing and delivery expenses can usually only be apportioned on a basis determined by factors involved in marketing.

Examples of items appearing under the respective headings are as follows :

<i>Administration.</i>	<i>Distribution.</i>	<i>Selling.</i>
General Office Expenses.	Warehouse Rent.	*Advertising, Samples, Folders.
Managing Director's Remuneration (if necessary apportioned).	Warehouse Labour and other Expenses.	Rent and other Expenses of Selling Office and Show-rooms; *Royalties.
Professional Fees.	Depot Expenses.	Travellers' Salary and Commission.
General Stationery.	*Finished Stock Waste and Loss.	Market Research.
Bank Charges.	*Carriage.	Certain Trade Subscriptions.
Rent, etc., of Office.	*Packages and Containers for Despatch Purposes.	Tendering and Estimating.
	Finished Stock Insurances.	*Bad Debts.

* See comments below.

The following observations on a few items must be noted :

Finished Stock Waste and Loss. Distinguish between

- Unavoidable waste due to inherent qualities, *e.g.* shrinkage, evaporation, breaking bulk.
- Deterioration due to lapse of time, obsolescence, and abnormal damage or abnormal loss.
- Avoidable waste caused by faulty handling, storing, etc.

Losses like group (b) are probably best written off direct to Profit and Loss, but (a) and (c) included as part of the distribution overhead.

Carriage on Goods Despatched. When chargeable to customers this is a direct charge on individual orders and excluded from overhead; otherwise it is a distribution expense, although by some it is included in Selling Overhead, being regarded as an inducement for buying.

Carriage on Returns of faulty goods due to bad manufacture is a Works Expense; but if due to bad packing is a Distribution Expense.

Bad Debts. When a fairly regular percentage of bad debts is incurred this item may be rightly included in Selling Overhead. When a large bad debt is exceptional or abnormal it is probably better excluded, and written off to Profit and Loss, as in the case of other exceptional losses of capital.

Royalties and other specific charges against particular lines, e.g. Sales Royalty on a patented article, are best shown separately so that they may be charged against the product concerned.

Packing, Wrapping, etc., essential for protecting or containing an article in a form necessary for supply to the consumer is a Production Expense, but other forms of packing, casing, etc. for despatch from the works are Distribution Expenses.

* *Advertising* by Permanent Signs, Neon and Electric Signs, etc. Capital Outlay is generally apportioned over the estimated effective life of the sign. Special Shop Displays and similar expense will be charged in Overhead. The expense can be spread over a longer period than a year if the expense is still found to be effective. An extensive advertising programme may be similarly spread.

General Administration Expense, sometimes called "Establishment Charges," is generally added as a percentage of total manufacturing cost, but sometimes as a charge per unit when unit output costing is applicable. It has no relation to such factors as are used for apportionment of factory expense.

Distribution Expense and Selling Expense.—Almost all industries have different problems affecting the allocation of these expenses. Consideration of sales planning and delivery differs in the case of (a) those businesses which rely on orders taken before production, e.g. heavy industries, such as steel works, makers of boilers, ships, locomotives, bridges, etc., who produce to customers' requirements. (b) Businesses selling from stock, e.g. tinned foods, medicines, soap, chocolate, hosiery, motors, etc.

As to the identification of selling and delivery expenses, it is usual to regard these as all expenses incurred on goods after

they have been placed in the warehouse or finished stock store, or handed over to the Despatch Department.

Selling Expense is usually allocated on a flat rate basis as a percentage of sales value, or proportionate to effort, by lines.

Delivery Expense as an amount per unit, per unit of weight or of quantity.

For Control Purposes, however, an analysis of Selling Expenses is often made: (a) by classes, (b) by areas, districts, or territories, and (c) by salesmen or agents.

Where possible, allocation is made direct to particular products or groups, otherwise being apportioned according to sales turnover of each in value, numbers, or quantities, whichever is the more equitable. Modern sorting devices and tabulating machines greatly facilitate this work in the case of large users.

In some undertakings selling and delivery overhead is charged against each line of article, pack or group, or sometimes each area, and by sales analysis the net profit or loss is obtained by using a schedule as follows :

Articles or Area.	Works Cost.	Administration Overhead.	Selling Expenses.	Distribution Expenses.	Total.	Sales.	Net Profit or Loss.

In suitable cases separate analyses of Wholesale and Retail Sales may be undertaken.

Expenditure Excluded from Cost.

It is hardly necessary to observe that various expenditures on capital additions, capital losses and payments in the nature of disbursement of profits cannot be included properly in manufacturing or operational costs. Examples are national taxation (income tax, national defence contribution); expenses of raising capital, discount on loans or debentures; bonuses to directors and employees voted at annual meetings, which are appropriations of profits; and losses on investments.

It is regarded as undesirable to include financing expenses, and exceptional losses of a non-recurring nature, e.g. abnormal manufacturing loss or waste through misadventure.

Expenditures and Losses Inadmissible to Cost of Government Contracts when the price is based on costs have been specially mentioned in various official reports and publications both in Great Britain and the United States of America. These include not only items mentioned in the preceding paragraph; but others which, although normally included in general commercial costs, are not regarded as applicable or appropriate to the performance of specific government contracts. The following list comprises items named in various official publications issued in the U.S.A. or this country. For the guidance of students the items have been suitably grouped, and suggested reasons added :

1. *Interest on Capital*, borrowed or otherwise, however represented, including Bank Interest charges. Interest is regarded as an element of profit covered by the profit allowed on the contract. In effect, the interest on borrowed capital constitutes the lender's share in the profit representing the return on the money virtually invested, and the balance of the profit on that borrowed capital is the share due to the contractor for his management of the money and production. When looked at in this light interest is clearly not an item of cost.

2. *Capital Assets, Losses of*, arising from sale, exchange, or uninsured destruction. Fees of assessors and advisers on such destruction losses (fire, etc.) come under this heading, being unrelated to operating cost.

3. *Amortisation or Writing Down of unrealised appreciation* of assets values, e.g. Plant and Buildings.

4. *Losses on other contracts*.

5. *Legal and Accounting Fees* specifically incurred in connection with reorganisations; security issues; issues of capital stock or shares; patent registrations and infringements; anti-trust litigation (U.S.A.); prosecution of claims of any kind, including taxation matters, against the government.

6. *Life Assurance Premiums* on the lives of officers (other than insurances against risks from explosions and other risks connected with manufacturing).

7. *Stamp Duty, Taxes (U.S.A.), and Expenses* on issues and transfers of capital stock, shares and bonds, etc.

8. *Investments, Losses on*.

9. *Finance Charges*, discounts on bonds, debentures, etc.

gated, as Treasury Order No. 5000 under Section 2 (b) of an Act of June 28th, 1940, and other provisions (commonly called the Vinson-Trammell Act). Many were referred to in the official publication entitled "Report (No. 2) of the Treasury Standing Committee on Co-ordination of Departmental Action in regard to Contracts (Colwyn Committee)," published by H.M. Stationery Office, 31st October, 1918. ✓

EXAMINATION QUESTIONS

[Note : In this book "Overhead" is used instead of the term "Oncost."]

1. Define "oncost." Give twelve examples of such expenses.—*Royal Society of Arts (Advanced)*.

2. In valuing Work in Progress at stocktaking, is it right to include Oncost Expense in the valuation, or only Wages and Material Cost? Give reasons for your answer.—*Association of Certified and Corporate Accountants (Final)*.

3. A part of the products of a factory is of a seasonal nature, e.g. Christmas puddings. How would you propose to apportion Oncosts to such products?—*Royal Society of Arts (Advanced)*.

4. Prepare a statement of standing order numbers for classification of overheads, showing as many headings as possible under "Works," "Administration," and "Selling and Distribution."—*Institute of Cost and Works Accountants (Inter.)*.

5. How would you treat the following expenses in your Cost Accounts :

(a) Advertising expenses; (b) Apprentices' premiums; (c) Fire insurance premium; (d) Workmen's Compensation Act Insurance premium; (e) Salesmen's commission; (f) Carriage charges?—*Royal Society of Arts (Advanced)*.

6. A manufacturer, working at high pressure, incurred considerable expenditure in overtime wages. Assume that the direct wages method of allocating Oncost is in use in this case, what effect do overtime wages have upon this method? Do you consider that the additional payment for overtime should be regarded as direct or productive wages, or should they be treated as Oncost? Give your reasons.—*Association of Certified and Corporate Accountants (Final)*.

7. State the various sources from which Oncost expenses arise and what means you would adopt for their collection, prior to allocating them to departments or absorbing them on the products.—*Royal Society of Arts (Advanced)*.

8. In all large works, wages expenditure is incurred on engineers and millwrights engaged continuously on repairing machinery, running the power plant, and maintaining the general equipment of the works in good order. They are also frequently engaged on work, the cost of which is charged to Capital and not against Revenue. Their services extend to all the manufacturing departments. State very briefly how you would secure weekly information as to

(a) Capital expenditure.

(b) Wages expenditure incurred in connection with the power plant.

(c) Wages expenditure chargeable to each Manufacturing Department.

Association of Certified and Corporate Accountants (Final).

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9. The following figures give the experience of two manufacturers as regards the relation of Bad Debts to Sales during five separate years :

	1. £	2. £	3. £	4. £	5. £
A. Sales . . .	127,500	113,460	140,989	150,604	151,728
Bad Debts . .	—	757	—	—	1,592
B. Sales . . .	73,846	64,504	69,211	71,409	79,207
Bad Debts . .	494	407	652	729	648

Would you reckon Bad Debts as part of the Selling, Delivery, and General Administration expense in both cases?—*Association of Certified and Corporate Accountants (Final).*

10. The following is a summary of the expenditure of a business for 19.., viz. :

	£	£
Materials consumed		24,927
Direct Wages—		
A Department	11,469	
B " 	7,892	
C " 	10,974	
		30,335
Oncost—		£55,262
A Department	16,280	
B " 	3,426	
C " 	9,842	
		29,548
Total Manufacturing Cost		84,810
Selling, Delivery and General Administration Charges		16,962
Carriage outward		4,728
Royalties on Golf Balls sold		746
Bad Debts		250
Discounts allowed to customers		2,700
		<u>£110,196</u>

Can you suggest any reasons for the four last items being separately stated and not included in the Selling, Delivery, and General Administration Charges?—*Association of Certified and Corporate Accountants (Final).*

11. Do you consider Bad Debts to be part of the Oncost of a business? Give reasons for your answer.—*Association of Certified and Corporate Accountants (Final).*

12. The Selling and Distribution Expense of a manufacturing business is usually provided for in individual costs by a percentage applied to the total Works Cost of each article. Is there any special reason for so doing? Why is it necessary to distinguish between the Oncost expenditure of manufacturing departments and the expenditure involved in marketing the products?—*Association of Certified and Corporate Accountants (Final).*

13. What do you understand by fixed oncost and floating oncost? In a time of exceptional trading depression when selling prices are below the cost of production, what policy would you recommend a manufacturer to adopt in relation to Oncost rates when in keen competition with other suppliers?—*Association of Certified and Corporate Accountants (Final).*

14. How would you deal with the following matters in stores records, and what procedure would you adopt :

- (a) Gain or loss in weight through climatic conditions.
- (b) Breakages in stores.
- (c) Scrap returned to store.
- (d) Excess materials requisitioned returned to store without an advice?—*Institute of Cost and Works Accountants (Inter.)*.

15. Explain the term "Standing Works Order," and give a representative list of such orders.—*Institute of Cost and Works Accountants (Inter.)*.

16. Detail the main headings of selling and distribution expenses in any industry with which you are familiar and say how you would propose to recover them.—*Institute of Cost and Works Accountants (Final)*.

17. At the present moment a considerable expense is incurred in preparing for tenders for contracts, many of which are not obtained. What charges are involved and how are these expenses dealt with in your cost accounts?—*Institute of Cost and Works Accountants (Final)*.

18. Prepare a system of symbols whereby the direct and indirect expenses of production may readily be distributed to the proper location for recovery.—*Institute of Cost and Works Accountants (Final)*.

19. Overhead expenses fall into various groups; name these groups and give examples of the expenses of which they are comprised.—*Institute of Cost and Works Accountants (Final)*.

20. Explain how overtime payment is made up in any industry with which you are familiar. Fully describe the method of payment as it concerns—daily overtime, intermittent late working and night-work. Under what circumstances is overtime payment chargeable as direct wages or alternatively as overheads?—*Institute of Cost and Works Accountants (Inter.)*.

21. Certain steel and other bar work is kept in the stores and a sawing machine is installed so that requisite lengths are cut, as required, before serving out to shops. Show how you would ensure the cost of handling and cutting being added to the issue price.—*Institute of Cost and Works Accountants (Inter.)*.

22. Along with materials stocked for customers' requirements certain materials belonging to customers are also stocked. Should both bear the same charges for storing and handling or how would you differentiate between them? What expenses would be affected?—*Institute of Cost and Works Accountants (Inter.)*.

23. A manufacturing concern whose selling expenses are greatly divergent for various products requires a suitable basis for allocation. What method would you recommend?—*Institute of Cost and Works Accountants (Inter.)*.

24. A certain organisation finds it necessary to divide its expenses under three headings, viz. :

Factory Expense, Commercial Expense, and Erection Expense.

Under which heading would you place the following :

Shortages discovered on site; Transport; National Health Insurance; Advertising; Estimating; Design; Depreciation of Plant Machinery?

Would any such expense fall under more than one of the headings specified?—*Institute of Cost and Works Accountants (Inter.)*.

25. In what circumstances would you propose that the bonus paid for overtime or for night shift should be charged to :

- (a) the particular jobs worked upon during the overtime or night-shift periods;
- (b) the shop overhead expenditure;
- (c) general overhead expenditure?

Institute of Cost and Works Accountants (Inter.).

26. Spoilt work is inevitable in most factories, but unless kept under control may tend to become excessive. What method of keeping this in check would you adopt?—*Institute of Cost and Works Accountants (Inter.)*.

27. A serious fire occurs at a works and it is found impossible to recover more than half the value of the damage. What effect will this have upon the subsequent costs?—*Institute of Cost and Works Accountants (Final)*.

28. The following items appear in the Trading and Profit and Loss Accounts of a company :

- (a) Debenture Interest.
- (b) Bank Interest.
- (c) Schedule A. Income Tax.
- (d) Cash Discount on Purchases.
- (e) Advertising.
- (f) Commission on Sales.
- (g) Rebate on Sales.
- (h) Cash Discounts allowed.
- (i) Import Duties.

State with reasons :

- (1) What items you would include in costs ?
- (2) What uses would be made of the other items when fixing selling prices ?

Institute of Cost and Works Accountants (Final).

29. Define :

Chargeable Expenses,
Selling Expenses,
Fixed Oncoast,
Fluctuating Oncoast,
Administration Expenses,

and give three examples of items which would be included under each heading.—*Association of Certified and Corporate Accountants (Final)*.

30. A manufacturer groups his expenditure for costing purposes under the following main headings : (a) Cost of Manufacture; (b) Manufacturing Expense; (c) Administration and Selling Expenses. (i) Enumerate the items you would place under each heading, taking a manufacturing business of your own selection. (ii) Do you consider it necessary or advisable to elaborate the main headings as set out, and if so, to what extent?—*Chartered Secretaries (Final)*.

31. From the following particulars prepare a Profit and Loss Account in such form as you consider would be most useful for the Costing Department.

	£		£
Opening Stock :		Carriage on Purchases	550
Raw Materials . . .	24,500	" on Sales . . .	950
Finished Goods . . .	5,450	Rent and Rates (a) . . .	3,360
Closing Stock :		Fuel, Gas, etc. (a) . . .	960
Raw Materials . . .	21,450	Repairs to Plant . . .	650
Finished Goods . . .	3,900	Depreciation of Machinery	1,050
Wages :		Repairs to Premises (a) . . .	800
Productive . . .	17,350	Office Expenses . . .	1,970
Non-productive . . .	3,250	Purchases of Material . . .	73,650
Salaries . . .	3,400	Sales . . .	124,700

One-sixteenth of items marked (a) to be taken in respect of the Offices as distinct from the Works.—*Chartered Accountants (Final)*.

32. Under what circumstances do you consider that Selling and Distributive Expenses should be brought into Cost Accounts? What

items of expenditure would come in that category?—*Incorporated Accountants (Inter.)*.

33. Define:—(a) Fixed Oncost; (b) Fluctuating Oncost.

State six items of expense which would be included under each heading.—*Association of Certified and Corporate Accountants (Final)*.

34. Prepare a Schedule showing allocation of Oncost between three departments of a factory, viz.:—A, B, and C. The expenses for the year ended 31st March, 19.., extracted from the financial books are as follows:—

	£
Electric Light	250
Electric Power	640
Heating,	300
Workmen's Compensation Insurance	140
Fire Insurance on Plant	64
Depreciation on Plant at 10 per cent. per annum	300
Plant Repairs	256
Material handling charges	500
Rent and Rates	750

You also obtain the following information:—

	"A" Dept.	"B" Dept.	"C" Dept.
Direct Wages on Production	£2,400	£1,600	£3,000
Floor Space	30 per cent.	20 per cent.	50 per cent.
Direct Wage Earners	20	17	33
Materials Used	£2,000	£2,000	£4,000
Value of Plant	£1,000	£500	£1,500
	(20 machines)	(12 machines)	(32 machines)

Calculate the total oncost allocated to each department as a percentage on the direct wages, and show the basis of your allocation for each item of expense.—*Association of Certified and Corporate Accountants (Final)*.

35. On what bases would you analyse the following selling and distribution expenses over a number of different types of commodities sold by a firm:—

Travellers' salaries and commissions; Expenses of warehouse; Storing finished goods; Advertising on a national scale; Expenses of own delivery vans; Sales manager's salary; Sales office expenses; Expenses of returnable packages; Expenses of provincial depots?

Institute of Cost and Works Accountants (Final).

36. (i) Design a form which provides for the following information:

Sales divided between

(a) Wholesalers.

(b) Retailers.

(c) Manufacturers.

Products divided into four groups A-D.

For each product under each sales group the following should be given:

(d) Quantity sold.

(e) Cost, which includes costs of selling and distribution.

(f) Sales turnover.

(g) Amount of profit, and profit as a percentage of sales.

Complete the form with suitable figures.

(ii) How would you divide Selling and Distribution costs over the three groups of customers?

Institute of Cost and Works Accountants (Final).

CHAPTER X

OVERHEAD (*continued*)

DEPRECIATION AND INTEREST

Depreciation of Assets.—Depreciation is one of the items of fixed overhead, and adequate statistical data must be kept to ensure proper computation of the annual charge to be included in the accounts.

Depreciation represents the loss in value of the capital sunk in buildings, plant, machinery, and other equipment, due to normal and inevitable deterioration during the life of these assets. The term connotes a gradual though sure diminution in value through use. The cost of fixing new plant is capitalised and depreciated with the plant. The refixing of plant moved to another position is not capitalised but included in Overhead.

The definite determination of the exact amount of the loss due to depreciation is difficult, and various methods have been suggested and used.

It is necessary to distinguish between normal depreciation and other forms of loss in value of assets, thus :

Depreciation is the normal deterioration in value which takes place during the life of an asset. It is the loss in value due to use, abuse, wear and tear, the natural elements, or passage of time.

Obsolescence is the process by which an asset loses its value by falling into disuse, other than by wear and tear. The term is generally used to indicate loss of value of an asset, such as a machine or building, which is discarded before the expiration of its normal life, usually because of its inability to compete with one better adapted, or of more modern type. Thus the idea here is of sudden not gradual diminution in value. Again, if plant is scrapped before the costs of plant and fixing (when new) have all been written off, the balance of both capital value of the plant and the fixing of it are written off to Obsolescence Account.

Depletion is the exhaustion which takes place in natural resources by the removal of the valuable material inherent therein, *e.g.* by the extraction of raw materials from mines,

quarries, clay beds, gravel banks, forests and woodlands, oil, and other minerals from the ground, etc.

Inadequacy is a term that may be used to indicate the measure of inability of an asset, such as a machine, or building, to meet the demands of production made upon it.

The Fundamental Theory of Depreciation is parallel with the theory of investment, viz. that an investment should return interest whilst the principal is maintained undiminished until withdrawn. Applying this principle to buildings and machinery, it will be evident that, inasmuch as these assets will at some future time become valueless, despite the provision of maintenance and repairs, it is necessary, at regular intervals, to reserve from income an amount equal to the loss, so that at the time their useful life terminates there is a reserve on the books, which, with the residual value of the asset, will be equal to the original cost. Or, put in another way, there is sufficient reserve to replace the asset without diminishing the original capital. This reserve is represented by the depreciation which must be included as part of the cost of manufacturing. Before describing the methods for measuring depreciation, obsolescence may be considered with advantage.

Obsolescence, being of a different nature, is dealt with in another way. Obsolescence cannot, as a rule, be accurately anticipated, and its measurement is ascertained when it occurs.

In the case of a machine, an improved model, or a new invention, may render it necessary to make a change to enable the production costs to be kept low enough to be competitive.

Should loss occur through obsolescence, it is sometimes the practice to write off direct to Profit and Loss Account, in order that comparative costs may not be obscured by such an exceptional item. In some industries, and particularly when unexpected changes in design, or in processes tend to occur, obsolescence is anticipated and provided for to some extent by adding a suitable amount to the normal rate of depreciation. This latter method is approved by many accountants, and was expressly recognised by the British and American Governments in connection with contracts for war-time supplies requiring special plant, which, except for salvage, would have no substantial value to the manufacturer when the contracts were completed.

The Computation of Depreciation.—The determination of the exact life of an asset, and the actual rate of decrease in its value

during that period, is not possible, and reliance on estimates is necessary. There are several methods which are used :

✓ (i) *The Straight-Line Method*.—This is a much used and recommended method, which is simple and effective and has the great advantage that the uniform charge affords better comparative costs. It requires little work for computing the amounts. The life of the machine, or other asset, is estimated, also the residual value. It has also been recommended by the Accountancy profession since January 1945.* The cost, less the residual value (plus the cost of fixing, in the case of a new machine), divided by the estimated years of life determines the annual amount of depreciation to be charged. A separate calculation should be made for each machine. Allowance will be made for *regular* working of two or three shifts.

If, subsequently, capital additions are made to any asset, the rate of depreciation will be adjusted by dividing the sum of the addition and the then value of the asset by the anticipated remainder of years of life.

The use of a Plant and Machinery Register (Fig. 46) described on p. 142 facilitates the ascertainment of depreciation charges.

(ii) *The Reducing Balance Method*.—A constant percentage rate of depreciation is determined, which is written off the reducing balance of the capital value, the rate being so fixed that, at the end of the estimated life of the asset, only the residual scrap value remains. In favour of this method it is argued that a heavier depreciation charge is borne in the earlier years when repairs are lighter, and that the assumed increasing repair cost is counterbalanced, in later years, by the reduced annual charge of depreciation. Such relationship between depreciation and repairs is obviously most haphazard.

Figs. 42, 43 show the rates commonly applied when the reducing balance method is used. It not infrequently happens that, when these rates are used in the financial accounts, heavier rates are adopted in the Cost Accounts. When this occurs, the increase has to be written back for reconciliation purposes.

(iii) *The Sinking Fund Method* in which a fixed annual sum is charged against profits, and a similar amount is invested in gilt-edged securities, or, alternatively, in an endowment insurance policy. Interest on securities is re-invested, and thus

* By the Council of the Institute of Chartered Accountants; Recommendations on Accounting Principles "Depreciation of Fixed Assets," January 13, 1945.

added to the fund, so that the depreciation rate is somewhat lower than in the straight-line method.

(iv) *The Annuity Method* is generally used for leasehold buildings. A fixed annual sum is charged as depreciation, this being debited to Profit and Loss Account, and credited to the

FIG. 42.

DEPRECIATION RATES

Asset.	Rate %.	Asset.	Rate %.
Buildings	2½	Motor lorries	15
Boilers	5	Steam "	15
Electric cables	3	Motor omnibuses	20
" motors	7½	" vans	20
" dynamos	7½	Machines, general	7½-10
" transformers	7½	Shafting	5
Engines, Diesel	10	Tools	5
" gas	5	Type (printers)	10
" steam	5	Rail wagons (own)	6½
" traction	20	Sulphuric acid plant	15
Electric furnaces	12½	Farm machines (motor) . .	15-22½
Patterns	20-50	" " (non-motor)	10

Note that foundations for machines are excluded.

FIG. 43.

TABLE SHOWING THE PERIOD REQUIRED TO REDUCE ORIGINAL COST TO 10 PER CENT. BY APPLYING DEPRECIATION RATES ON DIMINISHING BALANCE.

Rate.	Years (nearest).	Rate.	Years (nearest).	Rate.	Years (nearest).
Per cent.		Per cent.		Per cent.	
5	45	12½	17	30	7
6	37	15	14	33½	6
7½	30	20	10	40	5
10	22	25	8	—	—

Lease Account. This sum is calculated at a rate which allows interest on the diminishing balance to be debited to the Lease Account each year. The leasehold is thus considered as an investment earning interest, which is credited to Profit and Loss Account.

(v) *The Production Method*.—This is not often used, because of the uncertainty of future output, and a varying rate and amount of depreciation has to be calculated and applied. The intention is to distribute more equally the depreciation charge over the cost of the output. During periods of normal production the rate of depreciation is lower, and the total sum charged is higher than when output is below normal. When

output is low, the rate per unit is higher, but the total depreciation charge is lower.

Instead of using volume of production as the basis, productive hours may be used, but this may be unreliable, as provision is not made for the speed of operation, nor for the waiting, or idle, time.

(vi) *Revaluation Method*.—This method is sometimes used, particularly by builders and contractors. Plant is charged to a contract at book value, and, at the end of the contract, is revalued and credited, so that the contract bears the difference.

The method is applied to such items as Loose Tools, Laboratory Glass-ware, Horses, and, sometimes, Patterns. The procedure often adopted is to open a Loose Tools Account, etc., to which the cost is debited of all new tools (other than those purchased for a particular job which are debited direct to the job), and of repairs to tools. At the end of each accounting period, the amount of the revalued stock is credited, the difference on the account being the depreciation to be taken into expense accounts, thus :

FIG. 44.

LOOSE TOOLS STOCK ACCOUNT									
Dr.					Cr.				
19...			£	s. d.	19...		c/d	£	s. d.
Jan. 1	To Balance	b/f	510	10 6	Dec. 31	By Stock on hand			
Feb. 28	" Purchases	12	51	0 9		(per valuation)			
Mar. 31	" Materials	17	32	1 3		" Depreciation	27	641	14 0
"	" Wages	18	10	5 6				97	0 0
Nov. 30	" Purchases	22	81	4 6					
Dec. 31	" Materials	25	22	2 6					
"	" Wages	26	31	9 0					
			£738	14 0				£738	14 0
19...									
Jan. 1	To Balance	b/d.	641	14 0					

The Use of a Plant and Machinery Register.—In order that the total depreciation chargeable may be easily ascertained, it is a good plan to record particulars of each machine in a Plant Register, or Ledger, which may be in book or card form.

In Fig. 45 a form is provided for detailing particulars of machines of one class, a separate form being used for different groups. Each machine should be numbered to correspond with the entry in the register.

Another form of Plant Register is shown in Fig. 46. This makes provision for arriving at the value of plant in each shop, and the total amount of depreciation to be charged for each year. The amount of depreciation for each machine is also

shown individually, which is useful when making separate machine rates. The total balance values are useful for Costing and Balance Sheet purposes.

INTEREST ON CAPITAL

Interest on Capital as a Cost or Not.—Some accountants include interest as an element of cost, but many, probably the majority, do not. There are also instances where many consider it difficult to argue against the inclusion of an interest charge, as, for example, when material has to be stored for lengthy periods, such as whisky, wine, and timber, which must be matured or seasoned before use. If the timber is green when purchased, capital may be locked up for years; if timber, already seasoned, is bought, a supplier who has seasoned it must take the interest into account in his selling price, so that the purchase then cannot avoid the interest charge. Such allowance in selling price does not necessitate the debiting of cost with interest, as previously mentioned on page 57.

The weight of opinion seems to be against the inclusion of interest in the cost accounts, and on the grounds of expediency alone it will usually be advisable to adopt that view in normal circumstances, so far as a general interest charge is concerned. It may be observed that interest is not admissible to costs of government contracts (when the price is based on contractors' costs) either in this country or in the U.S.A. It is interesting to summarise the arguments which may be advanced both for and against including charges for interest on capital in the Cost Accounts :

In favour of including it :

(1) Interest is as much an item of cost as production wages. Wages are the reward of labour, interest the reward of capital. Human labour has often been displaced entirely by machinery, and the interest on the capital sunk in that machinery may be regarded as the "wages" of the machine. Interest is for the hire of capital.

(2) Real profit is not made until the "rent," or remuneration of capital, has been paid, as is the case when interest is included in cost.

(3) All production takes time, involving the retention of the fixed and floating assets which represent capital, and the inclusion of interest is a proper charge for that capital, whether

borrowed or not. Stocks for maturing, such as timber, whisky, beer, etc., cost more for rent and interest through holding them than unmaturing stocks, and it is reasoned that, though less obvious, the same factor affects all the assets.

(4) Comparative costs of various methods and processes cannot be true unless interest is taken into account, particularly where various grades of machinery, some very expensive, are used.

(5) Capital borrowed has to be paid a sum in interest. If this expense is incurred to make production possible, it is an expenditure which must be regarded as part of the cost. The manufacturer who uses his own capital should similarly be credited with a sum representing interest.

Against including it :

(1) Interest on borrowed money is a matter for internal adjustment of profit. A manufacturer working with borrowed capital cannot charge more for his products than others using their own money. Interest must, therefore, be regarded as an appropriation of profit to the lender for his financial contribution to the business, and, if charged, it should affect the financial accounts only, not the cost accounts, then the margin of profit is simply lower.

(2) The argument that interest is the reward of capital as much as wages are of labour is one of economics, not of costing.

(3) Even to include interest paid on borrowed capital only cannot be accepted, because it has no more connection with manufacturing cost than all the capital invested in the business. Interest in both cases is a matter of finance, not of manufacturing.

(4) Interest is merely an anticipation of profit.

(5) When manufactured stock is costed with interest included, the interest has to be written back for the purposes of the Balance Sheet, and Profit and Loss Account, which is an admission that interest is not a part of cost.

(6) The charging of interest in the Cost Accounts is an unnecessary complication, and may result in being misleading.

(7) The ascertainment of the capital employed during each costing period, and of the appropriate interest, is one of complexity and difficulty. The total capital in a business is continually changing in form in many ways and from day to day; assets and liabilities fluctuate; reserves, undrawn

profit, and working capital will vary from time to time. Also, the rate of interest on money is repeatedly changing, so that any fixed rate used in the Cost Accounts would not always be true.

(8) No useful purpose is served by introducing the complexities which accompany the inclusion of interest, and for expediency alone it should be omitted.

(9) Where comparisons of different producing units and costs, taking into account interest, are required, these can be made in suitable statistical statements or reports.

(10) The charging of interest on the value of stocks held for maturing purposes as an addition to selling price is admitted as correct, but it simply represents appreciation in value of the material from a sales price point of view.

It may be noted that those who argue against interest as cost are usually prepared to admit the charge when special funds in the form of loans have to be obtained for a specific contract. This is hardly logical.

In America the inclusion of interest is frequently accepted, and there are some accountants in Great Britain who include such a charge in costs, but in both cases from the point of view of ascertaining profit margins from particular production facilities or methods. It is not admitted in the costs of costed Government contracts in this country or America as stated on page 131.

Interest Charge Necessary for Comparative Machine Costs.—The comparative return from operating various machines, or plant, cannot be obtained correctly unless consideration is given to the capital invested in each. This also applies when considering whether manual or machine working is more profitable. The question whether loans or mortgages exist for financing is immaterial. A reasonable market rate of interest should be adopted, and, applying that rate to the capital cost of each machine, an amount to be included on the comparative cost is found. If interest is so debited in the machine rates for managerial information, it should be credited to a Factory Interest Account.

Adjustments when Interest is Included.—The amount debited for assumed interest in the Cost Accounts cannot be taken into the financial books, and an adjustment must be made to bring the two sets of accounts into agreement. This is effected in a Reconciliation Account or Main Control Account by summarising

the total interest taken into account, and adding the total to the profit shown by the Cost Accounts.

Again, the value of work in progress and stock in hand, if taken from the Cost Accounts, will need to be reduced by the amount of interest included, otherwise a profit not realised would be shown.

Formulae for Calculating Depreciation. (a) *Straight-line Method.*

Let P = original cost of machine, including cost of fitting and accessories,

n = number of years of estimated useful life of machine,

R = residual scrap or second-hand value at end of n years,

D = annual sum to be charged as depreciation.

Then to produce $\pounds(P - R)$ in n years

$$D = \frac{P - R}{n}.$$

(b) *Reducing Balance Method.* The annual percentage chargeable is constant; let this be k , and this applied to the reducing balance gives the annual sum to be charged, which may be called D_2 .

At the end of

The 1st year, the depreciation fund = $\pounds kP$.

„ 2nd year „ „ = $kP + k(P - kP)$.
 = $P(2k - k^2)$.
 = $P[1 - (1 - 2k + k^2)]$.

„ 3rd year „ „ = $P[1 - (1 - k)^2]$.

„ n th year „ „ = $P[1 - (1 - k)^n]$.

i.e. $P - R = P[1 - (1 - k)^n]$.

$$\therefore (1 - k)^n = \frac{R}{P}$$

and

$$k = 1 - \sqrt[n]{\frac{R}{P}}.$$

N.B.—The “ n ” root is obtained by the use of logarithms.

(c) *Sinking Fund Method.* The annual charge calculated is invested and earns interest.

Let r = interest on $\pounds 1$ per annum.

D_3 = annual depreciation charge to the fund.

Then, at the end of

The 1st year, the depreciation fund = $\text{£}D_2$.

„ 2nd year „ „ = $D_2 + rD_2 + D_2$.
= $2D_2 + rD_2$.

„ 3rd year „ „ = $3D_2 + 3rD_2 + r^2D_2$.

„ n th year „ „ = $\frac{D_2}{r} [(1 + r)^n - 1]$.

$$\text{i.e. } P - R = \frac{D_2}{r} [(1 + r)^n - 1].$$

$$\therefore D_2 = \frac{r(P - R)}{(1 + r)^n - 1}.$$

Comparison of the Effect of these Methods. The following comparative table shows the rate of accumulation of the depreciation fund for a machine where $P = \text{£}1000$, $R = \text{£}160$, $n = 21$ years and $r = 0.03$, i.e. interest at 3 per cent. per annum.

Years.	Accumulating Fund.		
	Straight-Line Method.	Fixed per cent. on Reducing Value.	Sinking Fund Method.
1	£ 40	£ 83.6	£ 29.4
2	80	160	59.68
3	120	232	90.88
5	200	353.4	155.6
9	360	544	298
15	600	730	544
19	760	809.4	737
21	840	840	840

EXAMINATION QUESTIONS

1. Describe the methods known to you of charging depreciation on plant and machinery, and express your opinion on each. In the case of a firm that has adopted the method of charging a fixed percentage annually on the diminishing value of the assets and where Oncoast is charged to the products by the machine-hour rate, how would you, in the build-up of these rates, treat two machines that were identical in type and capacity, one of which was new and the other ten years old?—*Royal Society of Arts (Advanced)*.

2. Assume the depreciation of a machine has been recovered but the machine is still rendering useful service. Discuss the position which thus arises.—*Institute of Cost and Works Accountants (Inter.)*.

3. Discuss briefly the question of providing for Interest in Cost Accounts.—*Institute of Chartered Accountants (Final)*.

4. The Linford Engineering Company—engaged on mass production work—decides to replace a Capstan Lathe by an Automatic Machine. The Capstan is capable of turning out a unit of a certain product every 20 minutes, while the Automatic has a capacity of the same output every 3 minutes.

State what considerations must be taken into account when the overhead expense rate which has been calculated is reviewed, particularly in regard to depreciation and obsolescence. Figures may be used by way of illustrating and supporting your answer.—*Institute of Cost and Works Accountants (Final)*.

5. Draft a suitable form for a Register of fixed plant, showing its original cost, annual depreciation provisions, additions, and any other information you think useful. Enter thereon particulars of three machines for the last five years.—*London Chamber of Commerce*.

6. How would you classify the fixed assets of a factory for the purposes of depreciation? What rates of depreciation would you propose to apply to each on a fixed or diminishing value basis, whichever you may prefer?

Into what categories would you place the following:

(a) Foundations for machines; (b) Internal steam mains and radiators; (c) Wharves; (d) Surface drainage works?—*Royal Society of Arts (Advanced)*.

7. How far and in what manner should the following be taken into account as elements of Cost:

Interest on Capital;

Depreciation (wear and tear);

Obsolescence?

Society of Incorporated Accountants and Auditors (Final).

8. For the purpose of comparing the costs of the same article produced by two different manufacturing organisations, A and B, how would you deal with:

(1) Bank Interest incurred by A and Mortgage Interest by B.

(2) Salary of Managing Director in A (A being a Limited Company), and the absence of any remuneration to the working proprietor of B (B not being a Limited Company).

(3) Rent paid by A. No rent paid by B (B owning its own premises).

(4) Depreciation charged in A's accounts only.

Association of Certified and Corporate Accountants (Final).

9. State your views on the question of the inclusion of Interest as an element of cost.—*Society of Incorporated Accountants and Auditors (Final)*.

10. The following charges are incurred by a manufacturing business:

(a) Repairs to Plant; (b) Repairs to Buildings; (c) Interest on Bank Overdraft; (d) Income Tax; (e) Carriage inwards and outwards.

State whether you would include all or any of them in costs of production, and of those which you consider should be included, indicate whether as direct or indirect charges.—*Society of Incorporated Accountants and Auditors (Inter.)*.

11. What method would you adopt in apportioning depreciation on plant and machinery departmentally?—*Society of Incorporated Accountants and Auditors (Final)*.

12. A machine written down to scrap value is continued in service. Could you or would you not continue to add depreciation to your costs: Discuss the situation which would arise.—*Institute of Cost and Works Accountants (Final)*.

13. When considering the rate of depreciation of plant and machinery, what influence would expenditure on repairs have upon your recommendations? Give reasons for your answer.—*Institute of Cost and Works Accountants (Final)*.

14. A firm of wine merchants store different vintages in their vaults for varying periods up to 50 years. What items of expense should they take into consideration in fixing prices for wines which have been stored for longer or shorter periods?—*Institute of Cost and Works Accountants (Final)*.

15. Define :

(a) Depreciation; (b) Obsolescence; (c) Capital expenditure; (d) Hourly rate; (e) Machine rate; (f) Works cost.—*Institute of Cost and Works Accountants (Inter.)*.

16. A machine, costing originally £1000, was reduced to £350 in the accounts by depreciation. An additional expenditure of £300 restored it to its original efficiency, and it was considered equal to new. How would you deal with this in the factory records?—*Institute of Cost and Works Accountants (Final)*.

17. A firm has reserves invested in War Stock. State fully the objections, if any, to the interest being used to reduce expenses.—*Institute of Cost and Works Accountants (Final)*.

18. Devise a form for plant recording purposes which would provide the Cost Accountant with the necessary information for the various types of machinery.—*Institute of Cost and Works Accountants (Final)*.

19. Discuss the different methods of depreciation, place them in order of preference, and cite cases to which the differing methods might be satisfactorily applied.—*Institute of Cost and Works Accountants (Final)*.

20. Assume that a bank overdraft has been incurred in order to purchase certain plant. Should the interest be charged to plant account or should it be merged in the general expenses? Give reasons in either case.—*Institute of Cost and Works Accountants (Final)*.

21. In some large works there is a tendency to accumulate obsolete stock or plant. What procedure would you recommend to ensure control of this problem?—*Society of Incorporated Accountants and Auditors (Final)*.

22. The following figures relate to the Capital and average turnover of three manufacturing businesses :

	A.	B.	C.
Capital employed	£157,500	£342,698	£96,427
Sales of Manufactures (av. of last three years)	£450,000	£300,000	£600,000

In preparing costs of individual products and making provision for profit what provision in your cost schedule would determine which of these businesses was the more profitable in relation to its capital? Work out an approximate example with the aid of the above figures.—*Association of Certified and Corporate Accountants (Final)*.

23. Briefly state the arguments for and against the inclusion of Interest on Capital as a charge against cost of production and discuss circumstances and cases in which the inclusion of such interest is (a) desirable, (b) not desirable. Give reasons for your answer.—*Incorporated Accountants (Final)*.

24. Electricity is purchased on the basis of "x" shillings per K.V.A. of maximum demand plus "y" pence per B.T.U.

What investigations would you make in order to decide upon the departmental apportionment of the total charge for a period? Assume that the load varies considerably from time to time in certain departments, and that meters are installed in all departments.—*Institute of Cost and Works Accountants (Final)*.

25. Draft a form of plant inventory for use in a large works department and explain its use.—*Institute of Municipal Treasurers and Accountants (Final)*.

26. What information would you require to be kept of plant and machinery to enable accurate and scientific costs to be obtained?—*Institute of Municipal Treasurers and Accountants (Final)*.

27. Distinguish between:—(a) Wear and Tear, and obsolescence; (b) Amortisation and depreciation; (c) Capital expenditure and revenue-earning expenditure.—*Institute of Municipal Treasurers and Accountants (Inter.)*.

CHAPTER. XI

OVERHEAD (*continued*)

APPORTIONMENT TO DEPARTMENTS AND CENTRES

Departmentalisation of Expense.—The incidence of overhead expense in a factory, or other producing undertaking, is unequal as between the various sections of the organisation, and, consequently, if the management is to be able to control the cost of production, the sections, or departments, must be defined, and the expenses apportioned in some equitable manner. For the purposes of control, sectional or departmental activities are largely delegated to foremen or managers, and the results of their efforts are measured by the volume and quality of the output, and, particularly, by the costs of production.

The cost records have to provide for the ascertainment of departmental or sectional costs, and for the allocation of these costs to the products which pass through the operating departments. The underlying principle is that, in addition to the prime cost of material and direct labour, all the overhead expense incurred up to the time the finished product is placed in the Finished Goods Store, or is ready for despatch to the customer, has to be regarded as part of the manufacturing cost, and be so distributed that each unit produced bears its correct proportion of the expense of each department through which it may pass. The management is then able to compare costs of the product within a department, or as between departments, and thus can measure efficiency, control the foremen better, and modify plans should this be necessary.

It is essential that, when there is more than one shop or department, a separate total of Overhead (or Oncost) must be ascertained and separate shop rates calculated as described in the next chapter, otherwise costs can rarely be correct.

Apportionment of Works Expense may, therefore, be defined as the process of determining the incidence of works expenses to departments and producing units or centres, and the division of those expenses proportionately. The apportionment may

Rates of Local Authorities when buildings contain rateable plant, *e.g.* boiler-house. It should be observed that machinery for manufacturing is not included in the rating assessment, but other fixed plant, *e.g.* main power transmission plant, is.* Also, when some buildings are old and others new, replacement values may have to be used because of the change in money values.

(4) An apportionment proportional to either—

(a) Superficial or *floor area* of departmental buildings, or

(b) The *cubic capacity* of departmental buildings, whichever gives the truer result, having regard to the nature of the expense, the buildings, and the type of industry.

Examples.—Lighting, heating, attendance, rent, fire precaution expenses, building service.

When the character of the buildings varies considerably, rent may be better allocated on capital value. Again, if the shops or rooms are of varying heights, cubic content may be a fairer basis than area in some businesses.

(5) An apportionment proportional to the departmental totals of *production hours* of (a) direct labour, or (b) in some circumstances, machines.

The direct labour-hour basis is usually the most equitable method of apportioning the majority of general overhead expense where a more closely related basis is not available.

Examples.—Overtime and waiting time expense. Works management, administration, and supervision. Works office expenses—stationery, sundries; Timekeeping and gate control; Experiment and research; Inter-departmental trucking. Such items as administration and supervision are often referred to as “unproductive time,” but it is rather a misnomer.

In departments where both machine and bench work are done, it will usually be necessary to divide the Overhead of the factory into items which vary with the running time of machines, and the operating hours of direct labour, and then to apportion the two totals of expense in proportion to (a) machine running hours or (b) direct labour hours, using separate expense rates.

* Rating and Valuation Acts 1925 and 1928, Sec. 24, and Plant and Machinery (Valuation for Rating) Order, 1927 (S.R.O., 1927, No. 480), summarised at p. 161.

When costing is used in a profession the method (a) is suitable for the apportionment of "unproductive time" to sections of the business, *i.e.* of office administration salaries (principals, clerks, juniors, stenographers, etc.) not chargeable as "direct" expense.

(6) Apportionment according to the *number* of employees in each shop is fairer for some expenses, *e.g.* canteen expense, timekeeping and wage department expenses, recreation ground and rest-room, etc.

(7) Apportionment by *technical* estimate, investigation, or measurement. Under this heading several useful methods are included, mostly of particular application, some of which are given by way of example :

Electric Light.—The number of lights or watts used in each department may be listed, and the departmental proportion of the total used charged to the departments. This is alternative to using floor area.

Electric Power.—Using a return of the operating time in connection with a schedule of h.p. of the machines in a department, a close estimate of the departmental charge is obtained. In some factories, departmental meters are used ; a return of kilowatts used gives the basis for apportionment.

Steam is apportioned on a consumption return. There are various methods of measuring steam used in departments. Sometimes, however, this charge is made, not on consumption, but on potential consumption, on the ground that the service is provided and available whenever required. One method is to base a minimum charge for standing expense and another per 1000 lb. for quantity consumed like a two-part tariff.

Water.—For process use hydraulic power will be metered and charged per 1000 gals. When not metered, a technical estimate may be used. In small businesses, where the water charge is based on rateable value, and the use is fairly uniform, the same basis of allocation as for rates may be used.

Compressed Air.—See remarks under Steam.

Gas.—Charge per 1000 cu. ft. metered.

Circumstances arise when some items of expense can only be estimated in consultation between the works engineer, the

works chemist, or other official, and the cost accountant, but such a course is to be avoided, if possible.

Departments for Costing Purposes.—These are not necessarily only production departments or shops. Sometimes a production “centre” or unit is treated as a “department,” instead of, or in addition to, the larger factory divisions. A “centre” may be an isolated work-bench, a machine, a group of machines of one type, or an activity. By this arrangement closer distribution of expense and more detailed control are aimed at. This method of minute departmentalisation of cost involves a considerable amount of analysis, and, in the majority of cases, the expense of the work would not be warranted. The value of the method lies in the more precise costs which are obtained, regardless of the variation in the product or the equipment. Unless great care is used in analysis, this elaboration may lead to erroneous results.

Service Departments are apportioned their fair share of the Overhead, in the same way as the operating departments. The total cost of each Service Department is afterwards distributed on a suitable basis to each of the operating departments concerned. The basis should be one which gives an apportionment proportional to user, which local circumstances will usually decide.

THE ANALYSIS OF EXPENSE FOR DEPARTMENTAL APPORTIONMENT

Preparation of Expense Summary.—The inequalities of the calendar month make it advisable to adopt either thirteen periods of four weeks to the year, or fortnightly periods. The use of summaries using calendar months makes comparisons unsatisfactory. Some mitigate the position by using in each quarter two four-weekly periods, and one of five weeks.

All Overhead actually incurred in each costing period may be usefully summarised in a statement drawn up to enable the management to compare the total expense under every heading, and to provide a check on the figures used in the accounts. (Fig. 47.)

In many factories a budgetary summary is prepared in advance, based on the preceding year's figures, suitably adjusted for probable trend in the coming year (or other period decided upon). Columns are usually provided so that actual expense may be inserted for comparison. (See Fig. 54.)

The Departmental Analysis of Expense.—The dissection of all items of Production Overhead expense into the respective Production and Service Departments has to be considered next. This procedure is applied to budgeted expenses for the year or as apportioned for other accounting and costing periods, and also to actual expenses for each costing period. It is necessary to use budgeted figures when overhead recovery rates have to

Fig. 47.

OVERHEAD EXPENSE SUMMARY

Four Weeks ended :													
1. Production (or Factory) Expenses.													
S.O. No.	Items.	Total.		Wages.		Pur- chases.		Stores Issues.		Petty Cash.		Trans- fers.	
	(Each detailed separately)	£	s. d.	£	s. d.	£	s. d.	£	s. d.	£	s. d.	£	s. d.
2. Administration Expenses.													
3. Selling and Distribution Expenses.													

be determined in advance, which is usually the case. The analysis of the actual expenses for each costing period reveals whether revision of recovery rates is advisable. The various bases of apportionment described in the preceding chapter, and in Fig. 52, are used. Wherever possible, expenses are charged direct to departments, and it is only when this is not possible that the apportionment methods are applied.

✓ *The Procedure.* All the items of production (or factory) expense are separately apportioned between (see Figs. 48-50) :

(1) General Overhead, affecting all departments, but which cannot be allocated direct to any.

(2) The Service Departments, as, for instance :

APPORTIONMENT OF FACTORY EXPENSES
Four Weeks to 28 February, 19...

Items.	Total as per Summary.	General Factory Overhead.	SERVICES.						PRODUCTION.			
			Buildings.	Electricity Supply.	Steam Supply.	Motive Power.	Stores Expenses.	Heating Service.	Lighting Service.	Dept. A.	Dept. B.	Dept. C.
Indirect Labour :	£	£	£	£	£	£	£	£	£	£	£	£
Foremen . . .	199	—	20	25	20	25	16	10	10	33	20	20
Storemen . . .	40	—	—	—	—	—	40	—	—	—	—	—
Shop clerks . .	32	32	—	—	—	—	—	—	—	—	—	—
Labourers . . .	256	—	20	10	40	10	—	—	—	50	70	50
Works salaries .	797	797	—	—	—	—	—	—	—	—	—	—
National Insurance .	200	—	2	1	1	1	2	1	—	92	84	84
Workmen's Con- pensation Insur- ance . . .	32	—	1	1	1	1	1	1	—	9	8	8
Fire Insurance .	30	—	20	—	—	—	10	—	—	—	—	—
Rent . . .	257	—	257	—	—	—	—	—	—	—	—	—
Rates . . .	208	—	272	—	26	—	—	—	—	—	—	—
Stationery, etc. .	20	20	—	—	—	—	—	—	—	—	—	—
Indirect Material .	179	—	—	5	5	15	4	3	—	45	52	48
Water . . .	11	3	—	—	11	—	—	—	—	—	—	—
Electricity and Gas Pur. . .	120	—	—	—	—	100	—	—	20	—	—	—
Coal . . .	582	—	—	210	220	—	—	122	—	—	—	—
Service Wages .	250	—	70	50	80	32	—	10	8	—	—	—
Repairs . . .	536	6	130	40	26	47	—	11	3	61	134	75
Maintenance . .	70	—	25	7	0	8	—	—	—	0	—	5
Stores adjustment .	20	—	—	—	—	—	20	—	—	—	—	—
Dining-room . .	70	70	—	—	—	—	—	—	—	—	—	—
Welfare . . .	40	40	—	—	—	—	—	—	—	—	—	—
Lighting Material .	30	—	—	—	—	—	—	—	30	—	—	—
Fire Protection . .	8	8	—	—	—	—	—	—	—	—	—	—
Depreciation . .	365	—	85	45	80	30	—	25	3	35	30	32
Transport (Internal)	100	—	—	—	—	—	—	—	—	36	24	40
Sundry Expenses .	257	257	—	—	—	—	—	—	—	—	—	—
Experimental . .	32	32	—	—	—	—	—	—	—	—	—	—
	£4903	1265	902	424	519	269	93	186	78	370	435	302

Note.—General Factory Overhead and Services are further analysed in Fig. 49; Final Apportionment to Departments in Fig. 50. Examples of the bases upon which apportionments above are made are suggested in Fig. 52 on p. 160.

- (a) Land and buildings expense.
- (b) Electricity supply expense.
- (c) Steam supply expense.
- (d) Motive power.
- (e) Stores expense.
- (f) Heating.
- (g) Lighting.
- (h) Plant maintenance.
- (i) Hydraulic vacuum, compressed air.

All auxiliaries
to the other
Departments.

(3) Production Departments, *e.g.* Dept. A; Dept. B; Dept. C.

It is then necessary to apportion the General Overhead (which has not been charged direct to any department) over all the Service and Production Departments affected. (Fig. 49.)

FIG. 49.

INTER-SERVICE DEPARTMENTS TRANSFERS.

Items.	Factory General Ex- penses.	SERVICE DEPARTMENTS.						
		Build- ings Ex- pense.	Elec- tric Supply.	Steam Supply.	Mot- ive Power.	Stores Ex- penses.	Heat- ing Ser- vice.	Light- ing Ser- vice.
Totals as per analysis (Fig. 48)	£ 1265	£ 902	£ 424	£ 519	£ 269	£ 93	£ 186	£ 78
Transfers from General ex- penses	-140	20	20	25	25	30	10	10
Buildings ser- vice	--	-340	50	100	80	60	30	20
Lighting ser- vice	--	--	--	10	10	27	4	-51
Heating ser- vice	--	--	--	--	--	18	-18	--
Steam service.	--	--	--	-202	--	--	202	--
Electricity ser- vice	--	--	-194	--	304	--	--	190
Total for allocation to shops	£1125	582	--	452	688	228	414	247

The total cost of each Service Department is then allocated proportionate to use, or in some cases potential use also, to the Production and other Service Departments. Note that some of these Service Departments serve other Service Departments for which an apportionment has to be made first. The final analysis, including the re-apportionment of the Services, is shown in Fig. 50.

Tool Department.—The Tool Department of an engineering works is responsible for the supply of

- (1) Special tools for specific works orders.

(2) Other tools for general departmental use in the works, including repairs, sharpening, etc.

(3) Tools occasionally for sale.

Fig. 50.

APPORTIONMENT OF SERVICES AND EXPENSES, BEING FINAL SUMMARY
BASED ON EXPENDITURE IN FIGS. 48 & 49.

Expense Item.	Total as Analysis. (Fig. 49)	PRODUCTION DEPARTMENTS.		
		Dept. A.	Dept. B.	Dept. C.
	£	£	£	£
General factory expenses	1125	320	398	407
Buildings expenses	582	180	202	200
Steam supply	452	298	154	—
Motive power	688	168	194	326
Stores expense	228	182	24	22
Heating service	414	131	129	154
Lighting service	247	80	82	85
Other expenses	1167	370	435	362
as per Analysis (Fig. 48)				
	£4903	1729	1618	1556

The cost of direct wages, material, and the appropriate proportion of the Tool Department Overhead expended on the special tools is a specific charge to the jobs concerned.

The other tools are charged as tool expense to the various departments that use this service.

An account may be drawn up as shown below.

Fig. 51.

TOOL-ROOM ACCOUNT.

Dr.

Cr.

	Direct.	General.		To Works Orders.	General (To Shops).
	£	£		£	£
To Wages	65		By Production		
„ Materials	123		Orders :		
„ Wages		39	(detailed)	200	
„ Materials		211	„ Charges to		
„ Expense Allo-			Standing		
cation Sum-			Order		
mary	12	14	Nos. :		
			Shop 1		76
			„ 2		69
			„ 3		84
			„ Balance		
			forward		35
	£200	264		£200	264

The expenses are allocated proportionately to direct labour hours, or departmental machine hours, in some cases.

The Basis of Allocation.—In the preceding chapter the methods of apportioning overhead expense were discussed. In the following schedule the application of these methods is indicated :

Fig. 52.

SCHEDULE SHOWING METHODS OF APPORTIONMENT OF CERTAIN ITEMS.

Expense.	Basis of Allocation.	DEPARTMENTS.				
		Source or Production.			Adminis- tration.	Selling.
		No. 1.	No. 2.	No. 3.		
Depreciation	Capital value of asset ; or for buildings floor space					
Electric power	Kilowatts used, or H.P. hours in each shop					
Steam	Consumption re- turn—metered or calculated for use and potential use					
Compressed air						
Hydraulic power						
Gas	Metered					
Electric light	Number of lights or total depts. watts floor space or number of workers					
Building ser- vice	Area or capacity of buildings					
Welfare	Number of workers					
National In- surance	Actual					
Workmen's Compensation Rates	Total wages paid					
	Department assess- ment values ; capi- tal values other- wise					
Heating	Area or capacity of departments					
Repairs	Direct in S.O. num- bers					
Dining-room expenses	Number of workers or labour hours					
Insurance	Capital values					
Overtime	Direct labour hours if not actual					
Stores expense	Number of requisitions or values or weight or direct wages, whichever suitable					

Example of Apportionment of rates and fire insurance in a foundry :

FIG. 53.

Department.	Rateable Value Buildings and Equipment.	Per Cent. per Dept.	Rates.	Fire Insurance.	Total.
	£		£ s. d.	£ s. d.	£ s. d.
Cupola Department . . .	3,000	3·15	1 3 1	1 11	1 5 0
Moulding Shop . . .	35,000	36·85	13 11 0	12 2 0	25 13 0
Core Shop . . .	10,000	10·52	3 17 11	6 6	4 4 5
Fettling Shop . . .	1,000	1·06	7 7	8	8 3
Smiths' Shop . . .	1,000	1·06	7 7	8	8 3
Machine Shop . . .	45,000	47·36	17 8 4	1 9 7	18 17 11
Totals . . .	£95,000	100·00	36 15 6	14 1 4	50 16 10 per month

✓ **Rateable Plant and Machinery.**—The basis of apportionment has been referred to on page 152 (par. 3 (c)). In order to establish the basis of division of the charge for Rates, regard must be had to the Plant and Machinery which is rateable. There are *five* classes of assets, in addition to Land and Buildings, which are rateable, under the provisions of Section 24 of the *Rating and Valuation Act, 1925*, and the *Machinery and Plant (Valuation for Rating) Order, 1927*. These provisions were made applicable to London by the *Rating and Valuation Act, 1928*.

The Rateable Classes, deemed to be part of the hereditament, are as follows :

Class 1a. Machinery and Plant used in connection with the generation, storage, primary transformation, or main transmission of power in the factory.

This includes :

- Steam Boilers (their settings, chimneys, furnaces, mechanical stokers, injectors, feed water pumps, economisers, etc.).
- Steam Engines, turbines, internal combustion engines, hot air engines.
- Engines and turbines (operated by steam, internal combustion, and hot air).
- Dynamos (couplings to engines and turbines, field exciter gear, etc.); Transformers, Cables and Conductors, Switchboards and other gear.
- Water Wheels, water turbines, sluice gates, etc.; Pumping Engines and other hydraulic plant; Windmills.
- Air Compressors, compressed air engines.
- Shafting couplings, clutches, pulleys, gears, etc.
- Steam and other Motors for driving any machinery or plant in this class.

EXPENSE ALLOCATION SUMMARY WITH BUDGET COMPARISON

Month ended.....

ITEMS.	TOTAL EXPENSES.		SERVICE DEPARTMENTS.*				MANUFACTURING SHOPS.							
			Steam.		Repairs.		Foundry.		Machining.		Automatics.		Assembly.	
	Budget.	Actual.	Budget.	Actual.	Budget.	Actual.								
	£	£	£	£	£	£	£	£	£	£	£	£	£	£
Foremen														
Management														
Inspection														
Rate-fixing														
Drawing Office														
Office staff wages														
Labour, indirect.														
General expenses														
Indirect materials														
Power-house (wages)														
Do. (materials)														
Depreciation														
Rents, rates, etc.														
Repairs and maintenance:—														
Tools														
Buildings														
Services Departments:—														
Steam £1,705	—	—												
Repairs £1,245														
	£	£10,005					£	£2,115	£	£4,305	£	£3,000	£	£645
	£	£9,240					£	£2,007	£	£2,867	£	£2,997	£	£1,288
Direct Wages														
								100%		150%		100%		50%
Percentage of expenses to direct wages †										

* As many columns as there are services.

† Or labour hour, or machine hour rate may be quoted.

in these circumstances, the Allocation Summary may be appropriately ruled to permit of regular comparison. A condensed summary on these lines is shown in Fig. 54. ✓

EXAMINATION QUESTIONS

1. It has been decided to omit from costs the expenses incurred in connection with idle facilities. What items would you debit to the account opened for this purpose and on what bases would you make your apportionments of common expenses?—*Royal Society of Arts (Advanced)*.

2. State briefly why it is desirable, as a general rule, to make use of different Overhead rates for each Department of a manufacturing business? In what circumstances would you consider this to be unnecessary?—*Association of Certified and Corporate Accountants (Final)*.

3. Under a system of piece-work there are certain indirect operations for which a day-rate is paid. In dealing with overhead expenses suggest how such day wages should be treated.—*Institute of Cost and Works Accountants (Final)*.

4. Describe fully a method of arriving at departmental hourly rates for Overhead.—*Institute of Cost and Works Accountants (Inter.)*.

5. State very briefly the chief benefits derived from a departmental division of Overhead expenditure:

(1) From a Costing standpoint.

(2) From the standpoint of financial control.

In what circumstances is departmentalisation unnecessary?—*Association of Certified and Corporate Accountants (Final)*.

6. State what procedure you would adopt to obtain a monthly schedule of departmental Overhead charges.—*Institute of Cost and Works Accountants (Inter.)*.

7. Describe the methods you would adopt to ascertain the cost of defective work. State the particular industry you refer to and say how you would propose to deal with the cost so ascertained.—*Royal Society of Arts (Advanced)*.

8. A factory generates steam from water pumped from its own wells by some of its own steam. In the cost accounts for these services a proportion of the total cost of each must be charged to the other, but until this has been done the total cost of each service cannot be ascertained. How should this difficulty be met?—*Institute of Cost and Works Accountants (Inter.)*.

9. Write careful notes on treatment in Cost Accounts of any two of the following:

(1) Material damaged in course of manufacture.

(2) Idle time of expensive machinery irregularly used.

(3) Expenditure in connection with a research department.

(4) Established charges during a period in which the factory runs on very short time owing to trade depression.

(5) Expenditure in connection with a Service Department maintained in connection with a manufacturing business.

London Chamber of Commerce.

10. Prepare a skeleton statement of the cost of production of electricity where the steam raised is used for the following purposes:

(a) generation of electricity;

(b) process work;

(c) shop heating.

Institute of Cost and Works Accountants (Inter.).

11. A factory incurs a liability of roughly £10,000 per annum on account of rates levied by local authorities. Into what categories would

you divide the fixed assets in order to departmentalise this charge; and how would you then proceed to apportion it?—*Institute of Cost and Works Accountants (Final)*.

12. B. & Co. are invited to quote for 50,000 tons of a commodity. The firm find that the total cost of production is £55 per ton, but are informed that the contract cannot be placed with them at a price higher than £52 per ton. B. & Co.'s overhead charges included in the total cost of production amount to £5 per ton, such overheads covering Management and Depreciation.

Under what circumstances would they be justified in reducing their quotation to £52 per ton?—*Society of Incorporated Accountants and Auditors (Final)*.

13. State how you would deal with the following in the cost records of a manufacturer, viz. :

- (a) Carriage Outwards.
- (b) Carriage Inwards.
- (c) Rent, Rates and Taxes.
- (d) Repairs to Plant and Buildings.
- (e) Fire Insurance Premiums.
- (f) Expense of Welfare Department.
- (g) Electric Power.
- (h) Scrap Material.
- (i) Foremen's Salaries.
- (j) Manager's Salary.

The factory consists of our Productive Departments, with the usual Stores, Offices, etc., and the Costs of each Department are prepared separately. State any additional information you would require to enable you to arrive at the amount to be charged to each department.—*Association of Certified and Corporate Accountants (Final)*.

14. State briefly the object of distinguishing between fixed and floating expense. The following is a schedule of the expenditure in three departments of a manufacturing business :

	Department.		
	A.	B.	C.
	£	£	£
Direct Wages	11,290	3,775	5,782
Indirect Wages	3,619	1,029	786
Toolmakers	542	629	311
Power consumed	1,047	273	196
Shop Sundries	184	100	126
Repairs to Plant	478	264	60
Depreciation of Plant	380	376	142
Rent and Rates	872	517	460
Stationery for Manufacturing Departments	28	37	15
Supervision Salaries	1,000	500	625
Storekeeper's Wages	175	142	130

Divide the oncost of each between fixed and floating oncost and show separately the fixed and floating oncost rates, measured in relation with the direct wages.—*Association of Certified and Corporate Accountants (Final)*.

15. There are six heavy machines in a certain machine shop, the capital costs of which were as follows :

No. 1, £4620; No. 2, £2780; No. 3, £825; No. 4, £1278; No. 5, £6429; No. 6, £2500.

The oncost of this shop was charged to costs on the direct wages method, the shop rate being 400 per cent. Machines Nos. 1 and 5 were used intermittently, but the others were almost continually in operation. What is the main objection to this method of allocating oncost, and

what steps would you propose to remedy this objection?—*Association of Certified and Corporate Accountants (Final)*.

16. Explain briefly the principles that should govern the allocation of overhead expenses in a manufacturing business between: (a) manufacturing and selling departments respectively and (b) the respective manufacturing processes.—*Chartered Accountants (Final)*.

17. "One of the advantages of a Cost System is its aid in the control of expenditure." Set out in summarised form the directions in which this control operates.—*Incorporated Accountants (Final)*.

18. How would you arrive at the amount to be charged against a particular job for Depreciation of Plant and Machinery in a Factory where the rate of depreciation varied on the different items and machines?—*Incorporated Accountants (Inter.)*.

19. Explain the man-hour method of distributing overhead costs, and show in what instances the method is best applied in preference to other methods. Give an illustration of the manner in which the hourly rate is computed, and calculate the cost of an imaginary article showing the application of the above principle.—*Incorporated Accountants (Final)*.

20. Define productive and unproductive time in relation to costing. Indicate methods by which unproductive time can be allocated in cost accounts, giving examples of their application to (a) a manufacturing business, and (b) a profession.—*Chartered Accountants (Inter)*.

21. On what classes of fixed assets are local rates assessable?—*Institute of Cost and Works Accountants (Inter.)*.

22. The boiler plant in a factory supplies steam for electrical generating plant, heating, and for certain manufacturing processes, in addition to a number of pumping units in the Works. The directors are considering the purchase of electrical power from outside. Indicate the principal costing factors which will influence their decision.—*Institute of Cost and Works Accountants (Final)*.

23. The following are details of A's Selling, Delivery, and General Administration Expense for 19.. :—

Selling Expense :	£	£
Provincial Travellers' Salaries and Commission	9,279	
London Agents and London Office Salaries and Expenses	5,426	
Stationery and Advertising	7,246	
Cost of exhibiting at Home Fairs	549	
	<hr/>	22,500
Delivery Expense :		
Carriage not recoverable from customers	2,540	
Warehouse Salaries	3,429	
Packing Materials	1,531	
	<hr/>	7,500
General Administration :		
Head Office Salaries	8,420	
Printing and Stationery	1,175	
Accountants' Charges	315	
Incidentals	785	
Insurance	115	
Rent and Rates of Head Office	1,250	
Depreciation of Office Equipment	40	
	<hr/>	12,100
Bank Interest	2,429	
Mortgage Interest	3,580	
Discounts allowed	11,891	
	<hr/>	17,900
		<hr/>
		£60,000

The manufacturing costs of goods sold during 19.. were :—

	£
Through Provincial organisation	82,568
Through London Office ;	217,432
	<hr/> £300,000 <hr/>

Calculate a Selling, Delivery, and General Administration rate for :—

- (a) Provincial Sales,
- (b) London Sales,

based upon the selling price.—*Association of Certified and Corporate Accountants (Final).*

24. In a combine the following services are centralised :—

- (a) Buying.
- (b) Selling.
- (c) Accounts Receivable and Payable.
- (d) Research.
- (e) Design.
- (f) Legal and Secretarial.

How would you allocate to the constituent Companies the costs of the above services ?—*Institute of Cost and Works Accountants (Final).*

- . (5) A rate per hour of direct labour.
- . (6) A rate per machine hour.
- (7) A rate per production hour.

It will be demonstrated that, in the majority of cases, methods (1) and (3) are unsound. They are often used, however, for convenience, with consequent inaccurate costs. Method (2) gives fairly reliable results in suitable circumstances and is much used, but it is often used unfortunately when greater accuracy would be obtained by methods (4) to (7).

Method 1. A Percentage on Prime Cost.—The total Overhead for the factory or each department is expressed as a percentage of the estimated total of direct material and direct labour, and the percentage rate so obtained is applied to each job, or works order.

<i>Example :</i> Factory Overhead £8,480	} If several departments these must be departmental totals.
Total Direct Wages £4,000	
Direct Materials £6,600	

Then the percentage to add to the prime cost of each job

$$\text{would be } \frac{£8,480}{£10,600} \times 100 = 80 \%.$$

This method must be unreliable, and, in the majority of instances, inaccurate. The only thing in its favour is that it is simple, requires but little effort to calculate, and is quick and convenient. The only time it could be accurate would be when materials used are equal in price, the wages uniform, and the equipment used exactly similar on every job.

The criticism may be summarised thus :

(a) There is practically no relation between overhead and the cost of material and labour, except where these two elements are constant.

(b) Jobs and processes usually involve the use of different types and values of machinery, or labour equipment, and the charge for these cannot be proportionate to prime cost.

(c) The time taken is not considered, so that no allowance is made for the disparity between wages earned by different workers due to varying wage rates and speed of working.

Method 2. A Percentage on Direct Wages.—The simplicity of this method has led to its being rather widely used, despite the inaccuracies it produces. It involves but little work to

The method can be used for charging overheads of office and administration in the case of professions, *e.g.* the wages and salaries of principals, clerks, juniors, and stenographers, not capable of a direct charge (sometimes referred to as "un-productive time" expenses) and general expenses may be costed as a percentage on "productive" or direct salaries charged on jobs. In view of criticism (b) on page 170, it would be more reliable if method 5 (page 172) were used.

FIG. 55.

COMPARISON OF EXPENSE RECOVERIES

	Time-Work at 2s. 6d. per hour.		Similar Work at 25s. per piece.	
	10 hrs.	15 hrs.	10 hrs.	15 hrs.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Material	3 0 0	3 0 0	3 0 0	3 0 0
Direct wages	1 5 0	1 17 6	1 5 0	1 5 0
Prime cost	4 5 0	4 17 6	4 5 0	4 5 0
Works Overhead 150 per cent. on wages	1 17 6	2 16 3	1 17 6	1 17 6
Production cost	£6 2 6	£7 13 9	£6 2 6	£6 2 6

Method 3. A Percentage on Direct Material.—Practically the same type of objections apply to this method as to Method 1. The value of materials is generally too uncertain a basis to adopt for distributing overhead to the product. It is, however, sometimes used, because it is simple to operate, but it would be difficult to find an instance in which it would produce sound costs. It requires but a simple example to show the fallacy of using the method; both costs are probably incorrect, one being over-charged, and the other under-charged:

COST OF METAL CAPS

	In Brass.	In Steel.
	£ s. d.	£ s. d.
Materials.	4 0 0	2 0 0
Labour	18 0	18 0
Prime cost	4 18 0	2 18 0
Works overhead 75 per cent. on materials	3 0 0	1 10 0
Production cost	£7 18 0	£4 8 0

The method necessitates additional records being kept, which causes some increase in clerical work, viz. :

- (i) The number of direct-labour hours spent on each job or works order in each department.
- (ii) The total number of direct-labour hours worked by all the workers in each department.

This extra work ensures more accurate costing, and provides information for better control of costs, so that actual total costs may be reduced.

Other advantages are :

- (a) The defects of the methods previously described are overcome in that the Overhead charged to each order is unaffected by any fluctuations in labour rates or earnings, or in the price of materials.
- (b) When used in conjunction with piece-work, satisfactory apportionment of Overhead is secured. If the piece-worker produces more units in a given time, he earns more, but the Overhead charge is less, being distributed over a larger number of units.
- (c) The time statistics collected are useful for measuring production efficiency without the less stable wages factor.
- (d) There can be separate direct-labour hour rates for sections within a shop or department, so that, if different types of equipment or machines are used in one department, the separate rates provide a reliable method for distributing Overhead. This procedure is more fully explained under the Machine-hour Rate method.

Method 6. The Machine-hour Rate.—The principle underlying this method is that Production Overhead expenses of a centre are distributable in proportion to the operating hours of the machines. In factories where production is largely by machinery, this method gives greater accuracy than any of those previously explained.

Considerable preliminary work is necessary to set up reliable rates, and the detailed records of time and expense call for additional clerical work and analysis, but the detailed costs secured will usually make the method well worth while.

A machine rate can be set up for each machine, but as, in a large factory, this method would probably create too many rates for convenient handling, and be too costly, it is often the

Overhead to be charged to a particular works order, whether that order represents a job, process, or operation.

A certain amount of discrepancy arises, however, owing to (i) the inevitable irregularity of operating time; (ii) the necessity for using an estimated number of running hours in advance. Again, the amount of idle or waiting time and overtime, if exceptional, affects the accuracy of the machine rate. A decided trend of increase in non-operating machine times, owing to a variety of causes, would call for a revision of the rate, which would have to be increased, proportionately, if it were desired to recover all factory expense in the costs, but, where machines stand idle in times of trade depression, the loss on this account is best written off to avoid altering the rates seriously, which would render comparisons difficult or produce grotesque comparisons; this does not apply to "stand-by" or spare machines or plant, *e.g.* electric motors.

If the machine-hour rates are fixed with due regard to existing and anticipated circumstances, they provide a reasonably reliable means for allocating the Overhead.

Computing the Machine-hour Rate. Method I.—Where separate rates are used for machine-work and bench-work in a shop :

(i) All Factory Overhead, excluding all specifically relating to machines, having been duly apportioned over the respective shops or departments, the total for each shop may be further divided, on the basis of floor area, between the respective machines and work-benches. A proportion of the area of gangways, staircases, etc., will be included in the floor area for each division.

(ii) To the factory overhead so allocated to a particular machine, or group of machines, the expense of each machine is added, *e.g.* power, repairs, depreciation, oil, etc.

(iii) The total general and machine expense so allotted to each machine is then divided by the estimated running hours for the year (or shorter period), and thus an inclusive machine-hour rate is arrived at. (See Fig. 56.)

Computing the Machine-hour Rate. Method II.—Only the cost of power, repairs, depreciation, oil, and expenses specifically affecting each machine are included in the rate. All other Factory Overhead is included in a separate shop-rate per direct-labour hour, or such other rate, or percentage, as may be selected.

Thus, one rate applies the machine expense to the product, and a second rate, or percentage, applies the general Factory Overhead.

The following is an example of a schedule for computing a machine-hour rate which includes shop expenses :

FIG. 56.

MACHINE EXPENSE SCHEDULE

Machine No. B. 23; Shop "A"

Description :.....	Date bought :.....
Maker :	Cost : £600.
Power :	Estimated life : 10 years.
Additions :	Depreciation : 9% p.a.

Item.	Basis of Estimate.	Cost per Annum. £
Depreciation	9% to reduce to £60 in 10 years	54
Insurance	Actual	2
Repairs and maintenance	Estimated from records or otherwise	64
Indirect materials : oil, cotton, waste, etc.	Estimated on average issues	10
Rent of floor space allotted	300 sq. ft. at 1s. 4d.	20
Superintendence and shop expenses	$\frac{5\%}{100} \times £1,800$ (say)	180
Power	302 days of 8 hours less 20% idle time, estimated	190
Cost per annum		£520
Cost per operating hour (1,933 hrs.) Use, say, 5s. 5d. hr.		5.38s.

When a separate shop rate is used for general Factory Overhead these charges are omitted from the machine rate. Additional columns may be added for subsequent changes in the expense and rate.

Adjustment of Overhead Expense Account.—It will be apparent that whatever basis is used for allocating factory expense, there is little probability of an *exact* recovery of the total expense—there will be a balance under-recovered, or over-recovered.

This balance is due to the necessity of (1) estimating what the total expense will be; (2) estimating the output and working hours. There would be under-recovery, for instance, when :

- (a) The total expense computed for a shop or department exceeds the estimate.
 (b) The output or hours worked are less than assumed.
 There would be over-recovery when :
 (c) The total expense is actually less than estimated.
 (d) The output or hours worked exceed the estimate.

The result is revealed in the Shop Expense Control Accounts, the principle of the operation of which is shown in Fig. 57 :

Fig. 57.

No. 4. SHOP EXPENSE CONTROL ACCOUNT

Dr.			Cr.		
10... Feb. 28	To Total expense apportioned to shop . . .	£ 720	10... Feb. 28	By Expense "recovered" by machine rates as per summary . . .	£ 598
			"	" Do. by direct-labour hour rates on hand-work . . .	103
			"	" Balance under-recovered transferred to Overhead Adjustment Account . . .	19
		<u>£720</u>			<u>£720</u>

OVERHEAD ADJUSTMENT ACCOUNT

Dr.			Cr.		
10... Feb. 28	To No. 1 Shop Expense Control Account . . .	£ 21	10... Feb. 28	By No. 2 Shop Expense Control Account . . .	£ 5
"	" No. 4 do. do. . .	19	"	" No. 3 do. do. . .	4
			"	" Balance written off to Manufacturing Account . . .	31
		<u>£40</u>			<u>£40</u>

There are three methods of disposing of the balance under— or over—recovered :

(1) By transfer to General Expenses, and absorbing it in new shop rates to be fixed ; this is undesirable, as it not only vitiates comparisons, but gives untrue results as between one period and another.

(2) By transfer to Manufacturing Account, or Profit and Loss Account, direct.

(3) By transfer to an Expense Adjustment Reserve Account.

When the balance represents unrecovered expense, it is usually best to transfer this to Manufacturing Account or Profit

and Loss Account, thereby showing the loss through expenses being higher than estimated, or due to short or idle time. The arguments in favour of this are that the amount has been actually lost; that it is unfair to saddle the production of the period following with expense incurred at an earlier period; and that true comparisons are obtained, which is not the case if balances are absorbed in subsequent expense rates. Similar considerations apply when over-recovery has taken place.

OBSERVATIONS

Idle Facilities and Idle Time Records.—Idle time of plant and machines represents a loss of a proportion of the expense which remains even when facilities are not in use. There is a small saving in power, and in a few other items. The cost of (a) intermittent idle or waiting time should be recorded separately from (b) the expense of idle plant, or facilities, in periods of short-time working, owing to depressed markets. To effect this, a weekly schedule of machine times worked and idle should be kept. The idle time (a) is charged up to Idle Time Expense Account at the appropriate rate for each machine; (b) is debited to Idle Facilities Account for transfer to Profit and Loss Account.

When part of the plant is necessarily used for only a portion of the total working hours, or can be used only seasonally, the total expense for both working and resting time is included in the rate, which is calculated according to the estimated number of hours to be worked so that the cost of this lost time is absorbed.

Similarly, if a reserve machine is kept to ensure no stoppage in production, the expense in connection with both machines must be included in Overhead and included in the machine-hour rate of the machine normally used.

The principle is the same for both reserve machines and machines used only during a particular season of the year, viz. the total cost anticipated for the year must be recovered on the limited hours worked. This procedure applies to idle time that is of regular and unavoidable occurrence, resulting from methods of production which necessitate having machines that cannot be kept fully employed. But when idle time is attributable to shortage of work due to business conditions, as during acute trade depression, the expense of idle plant is not included in the machine rate, but taken direct to Profit and Loss Account. Idle time due to delays between jobs, etc., or

due to shop management faults, etc., is usually included in Overhead.

Allocation of Special Fixed Bonus, War Bonus, etc., usually paid as a lump sum, *e.g.* a War Bonus of 10s. a week of 47 hours. The allocation of this to jobs may be on the basis of time worked on each. Where piece-rate only is paid to workers, the jobs may be converted into the equivalent in hours, and the bonus apportioned accordingly on the basis of Direct Labour hours.

EXAMINATION QUESTIONS

1. What do you understand by the term Machine-hour rate? Illustrate your answer by an example. What effect has restricted output upon a Machine-hour rate?—*Association of Certified and Corporate Accountants (Final)*.

2. Discuss the relative merits of charging out oncost on the following bases :

- (a) Time.
- (b) Direct labour.
- (c) Direct labour plus direct material.

Royal Society of Arts (Advanced).

3. In a Press Shop having several power presses are engaged three tool-setters.

- (a) How would you account for their wages in the labour costs of the several products?
- (b) If you were required to pay them upon results, what method would you adopt?

Institute of Cost and Works Accountants (Inter.).

4. The Overhead charges of a factory are allocated over the production on the "Productive Hour" basis. What do you understand this statement to mean?

A man and a boy complete similar jobs; materials cost £10 in each case. The man spends 12 hours on the work and is paid at the rate of 1s. 8d. per hour, whilst the boy takes 20 hours and is paid at the rate of 1s. per hour. Oncost is charged at the rate of 2s. 6d. per productive hour. Prepare a statement showing the cost in each case.

Do you approve of this method of allocating Oncost? If not, what do you suggest?—*London Chamber of Commerce*.

5. What do you understand by the term "Oncost"? Upon what basis should it, in your opinion, be calculated? State your reasons.—*Chartered Institute of Secretaries (Inter.).*

6. For what productions would you advocate the following methods of charging Oncost respectively? Give reasons.

- (a) Percentage on direct labour.
- (b) Percentage on direct labour plus direct materials.
- (c) Hourly labour rate.
- (d) Machine-hour rate.

Royal Society of Arts (Advanced).

Each was paid 9d. per piece. The cost department calculated by two methods the cost of output of each man as follows :

	A.			B.			C.			D.			Total.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Wages	3	0	9	1	16	9	2	14	9	3	7	6	10	19	9
Oncost on man- hour method	2	4	0	2	4	0	2	4	0	2	4	0	8	16	0
	5	4	9	4	0	9	4	18	9	5	11	6	19	15	9
Wages	3	0	9	1	16	9	2	14	9	3	7	6	10	19	9
Oncost on Direct Wages method	2	8	8	1	9	6	2	3	10	2	14	0	8	16	0
	5	9	5	3	6	3	4	18	7	6	1	6	19	15	9

Which do you consider the most reliable method of calculating the cost of the Castings made by B and D ? Why ? In adopting the man-hour method for the purpose of estimates generally, do you see any weakness in the method ?—*Association of Certified and Corporate Accountants (Final)*.

10. Explain the machine-hour rate method of apportioning Indirect Charges, giving an illustration of the method by which the hourly rate is ascertained.—*Society of Incorporated Accountants and Auditors (Final)*.

11. When applied to the allocation of Oncost what do you understand by the terms (a) labour-hour rate, (b) machine-hour rate, and (c) production-hour rate ? What would be the determining factor in each case ?—*Society of Incorporated Accountants and Auditors (Inter.)*.

12. The charges attributable to a particular department having been ascertained, on what basis should they be apportioned over the work done in that department ? Give reasons for your answer.—*Society of Incorporated Accountants and Auditors (Inter.)*.

13. In calculating " Oncost " what do you understand by the :

- Percentage method,
- Productive-hour method,
- Machine-hour method ?

Society of Incorporated Accountants and Auditors (Final).

14. Where a commodity requires a similar quantity of materials and time occupied by labour in the manufacture of a given output, what variable factors would require consideration from time to time in fixing the selling price of that commodity ?—*Society of Incorporated Accountants and Auditors (Final)*.

15. State the information required for arriving at a " Productive Labour Hourly Rate." What are the advantages and disadvantages as compared with :

- Percentage method of allocation of overheads.
- Machine-hour rate ?

Institute of Cost and Works Accountants (Final).

16. A certain operation is equally well performed by hand as by machine, but the flow of work is intermittent. You are required to examine the problems which arise and make recommendations.—*Institute of Cost and Works Accountants (Final)*.

17. Prepare a machine-hour rate to recover the overhead expenses indicated below :

	Per hour.	Per annum.
	d.	£
Electric Power	11½	
Steam	10	
Water	1½	
Repairs		53
Rent		27
Running Hours		2000

Original Cost Price, £1250.

Book Value, £287.

Present Replacement Value, £1150.

Depreciation, 7½ per cent. per annum.

Institute of Cost and Works Accountants (Final).

18. A group of manufacturers received a request for each firm to apply "Overhead" by a fixed percentage upon direct labour. Do you consider this a sound suggestion? Discuss the request.—*Institute of Cost and Works Accountants (Final).*

19. A certain factory pays its operators upon a straight piece-work basis (no job clocking). The National awards (war bonus), however, are only based on time-rate. How would you deal with these awards in job costs?—*Institute of Cost and Works Accountants (Inter.).*

20. Three operatives are given a job on a piece-work basis and their weekly rates are, for 47 hours, A—65s., B—47s., C—38s. respectively, plus a War Bonus of 10s. per week. The piece-price of the job is £8 and their times are A—42 hours, B—52 hours and C—36 hours. Calculate the bonus to be allocated to each and show the actual labour cost of the job, including War Bonus.—*Institute of Cost and Works Accountants (Inter.).*

21. Describe how you would measure the item of idle time and how you would deal with the same in your Cost Accounts.—*Institute of Cost and Works Accountants (Inter.).*

22. In ascertaining a shop hourly rate, what would you use as the basis? Give a list of the principal factors you would expect to include.—*Institute of Cost and Works Accountants (Inter.).*

23. In setting up machine-hour rates of absorption of overheads, what provision would you make year by year for depreciation of the machines engaged in production? How would you deal with expenses of plant of a general character?—*Institute of Cost and Works Accountants (Final).*

24. During a period of industrial depression, how would you deal with the expense relating to idle plant, assuming such expense to be considerable, and that the market conditions preclude its inclusion in estimate prices? Detail the main items comprising such expense.—*Institute of Cost and Works Accountants (Final).*

25. How would you proceed to determine machine-hour rates for absorption of overheads where the number of machines worked by one operator varies from time to time?—*Institute of Cost and Works Accountants (Final).*

26. During a period of acute trade depression, a manufacturer asks your advice as to continuing his costing system in view of the fact that the reductions in prices and turnover render the cost figures useless for the purposes of comparison and estimating. What advice would you give?—*Society of Incorporated Accountants and Auditors (Inter.).*

27. The Profit and Loss Account of a large Printing Works includes charges in respect of the following items :

Clerks' Salaries.
Stationery.
Interest on Loans.
Advertising.
Discounts.

Travelling Expenses.
Carriage Outwards.
Management Salaries.
Rent and Rates.
Auditor's Fees.

State carefully how you would proceed with regard to these items in preparing Cost Statements. In which cases should charges be made against individual printing jobs undertaken and how should the charge be ascertained?—*London Chamber of Commerce.*

28. State the matters you would take into consideration in deciding which of the following systems of allocating Works Oncost you would recommend for adoption in a particular trade :

- Prime Cost Method.
- Productive Labour Hour Method.
- Percentage on Direct Labour.
- Machine-hour Rate.

Association of Certified and Corporate Accountants (Final).

29. What is the man-hour method of allocating Oncost? In what circumstances would you recommend the adoption of this method? Give an example showing the method of calculation.—*Association of Certified and Corporate Accountants (Final).*

30. The following figures relate to one of the departments of a manufacturing business during the last five years :

	19...	19...	19...	19...	19...*
	£	£	£	£	£
Direct Wages . . .	18,742	23,691	21,840	17,640	14,781
Oncost : Floating . .	12,872	15,240	14,300	12,090	10,178
Fixed . . .	7,400	7,829	7,891	7,642	7,789

The year 19...* was abnormally depressed, and it is considered that the average of the other four years would form a satisfactory standard of output. (1) Calculate an appropriate rate of standard onc cost to the nearest 5 per cent. (2) Show what loss through unrecovered onc cost was suffered in 19...* (3) State what provision (if any) the standard onc cost made in 19...* towards the fixed onc cost.—*Association of Certified and Corporate Accountants (Final).*

31. In comparing the relative costs of production in two manufacturing organisations, x and y , how would you deal with :

- Depreciation charged in the accounts of x at the rate of $7\frac{1}{2}$ per cent. per annum on the diminishing cost and in the accounts of y at 5 per cent.?
- Debenture Interest paid by x and Bank Interest paid by y ?
- Rent paid by x ; no rent paid by y (owning its own premises)?
- Discounts allowed by x ; no discounts allowed by y ?

Association of Certified and Corporate Accountants (Final).

32. The following is a schedule of the expenditure in three departments of a manufacturing business, viz. :

Cost of Supplying and Installing One No. 6 Hydraulic Pump.

	£	s.	d.
Wages of foundry workers, machinists, fitters, and erectors	316	8	9
Materials	202	10	6
Wages and travelling expenses of outside erectors	38	2	10
Establishment charges 150 per cent.	835	13	1
	1,392	15	2
Profit 10 per cent.	139	5	6
	<u>£1,532</u>	<u>0</u>	<u>8</u>

State briefly what fundamental principles appear to be ignored in the calculation of this cost.—*Association of Certified and Corporate Accountants (Final)*.

33. What is the object of a manufacturer keeping records showing how much it costs to keep each machine in running order?—*Incorporated Accountants (Inter)*.

34. Discuss the various bases on which overhead expenses or oncosts may be distributed, and argue which of these bases you would recommend in the case of a cotton-spinning factory or other industry with which you are acquainted.—*Incorporated Accountants (Final)*.

35. The expenses of running an engineering factory for last year were: Rent and Rates £2,680; Fuel £3,261; Electric Lighting and Heating (gas) £478; Machinery Repairs £641; Insurance (Fire and Employers' Liability) £895; Interest on Capital £3,400; Wages, productive £32,000, non-productive £6,450; General Expenses £1,948; Depreciation of Machinery (10 per cent.) £3,865. There are three shops of equal size and capacity, but the machines employed differ considerably in cost and running hours. Which of the above items (if any) can, in your opinion be charged direct to the several shops, and which should be apportioned, and upon what basis?—*Chartered Accountants (Final)*.

36. What is meant by a machine-hour rate, and how is it arrived at?—*Incorporated Accountants (Inter)*.

37. B. MacArthur, a jobbing printer, makes a practice of adding to the prime cost of his jobs a percentage of wages and materials to cover oncost, such percentage being calculated on figures in the accounts of the previous financial year. In spite of the fact that each job appears to show a fair margin of profit and the overhead expenses have not materially altered, MacArthur finds that the Profit and Loss Account shows a loss at the end of the year. How do you account for this? If you do not approve of MacArthur's method of allocating oncost, how would you amend it?—*Chartered Accountants (Final)*.

38. Give a pro-forma account illustrating the method of calculation of a Machine-hour Rate.—*Incorporated Accountants (Final)*.

39. What information would you require and to what points would you give special consideration if called upon to plan a Cost System for any manufacturing business with which you are familiar (to be named)?—*Incorporated Accountants (Inter)*.

40. Where departmental overhead charges are allocated on the basis of labour only, what considerations should determine whether to apportion according to wages paid or time spent?—*Incorporated Accountants (Inter)*.

41. The following figures relate to a printing works for a year:—

	£		£
Total Sales	40,000	Lighting and Heating . . .	310
Materials used	6,900	Repairs to Machinery . . .	490
Labour	15,000	Plant Depreciation at $7\frac{1}{2}$	
Rent, Rates, and Water . . .	650	per cent. per annum . . .	720
Power	255	Other Overhead Charges . .	10,000

Included in the Plant are four Linotype machines occupying one-sixth of the total floor area. They cost £2,000 two years ago, and it is estimated that their scrap value in twelve years time will not exceed £200.

You are asked to work out a machine-hour rate, assuming any further details you may consider necessary.—*Incorporated Accountants (Inter)*.

42. Calculate Machine-hour Rate for Machine No. 7, which is one of seven machines in operation in a department of a factory. You are furnished with the following information:—

(1) Cost of Machine No. 7, £1,000.

(2) Estimated Scrap Value at finish of working life (10 years), £100.

- (3) Normal running hours per annum, 1,800.
- (4) Depreciation to be charged at 9 per cent. per annum.
- (5) Machine No. 7 occupies one-fifth of floor space of department, the Rent, Rates, Lighting, etc., of which amount to £350 per annum.
- (6) Charges for Electric Power supplied to Machine No. 7, £200 per annum.
- (7) Charges for Oil, Waste, etc., supplied to Machine No. 7, £30 per annum.
- (8) Repairs and Maintenance throughout working life of Machine estimated at £370.
- (9) Cost of Supervision and other expenses applicable to Machine No. 7 estimated at £150 per annum.

Labour Cost of operating the machine to be ignored in making your calculations.—*Association of Certified and Corporate Accountants (Final)*.

CHAPTER XIII

JOB OR TERMINAL COSTING

Job Costing is the method of costing jobs or contracts that are kept separate during manufacture or construction. A separate Cost Account is kept for each individual job, or contract, until completion of the work, when the account is closed, showing the total cost and the profit or loss made. Owing to the nature of this class of Cost Accounts, the designation Terminal Costing is often used.

This method of costing is applied to :

- (i) Contracts such as are undertaken by builders, general contractors, shipbuilders, constructional and mechanical engineers, etc.
- (ii) Job orders in factories and workshops.

The principle is the same for both groups, but there are, generally, a few points of difference in procedure, owing to the different nature of the work on large building and constructional contracts, as against the more numerous job orders dealt with in factories. Factory Job Costing is dealt with in the next chapter.

The Procedure.—It is usual to give each contract, or order, a distinguishing number to facilitate reference in the books, and on the various forms which are used. This number identifies the Cost Account to which are charged the cost of labour, materials, and expenses.

The Cost of Materials.

(a) *Stores Material.*—Materials from the Store are issued against a Stores Requisition (Fig. 10) which is the authority for the storekeeper to issue. Each requisition bears the number of the job for which it is required, and a weekly (or other period) summary is made, called a Materials Abstract, in which an analysis under job numbers is shown. (See Fig. 59.) The total value of the material under each job number is then debited to the appropriate Cost Account bearing the same number by posting from the Materials Abstract.

In some cases no Abstract is prepared, posting being direct from the priced requisitions (Slip posting method).

(b) *Direct Material*.—Sometimes material is purchased outside, or manufactured in the works, for a particular job or contract. The cost of this material will usually be debited direct to the Cost Account for the job concerned.

In the case of large constructional contracts, sub-contracts for specialised work or material, *e.g.* polished granite or heavy girders, are placed, the price for which is similarly a direct debit.

(c) *Materials Returned*.—It is sometimes necessary to issue certain kinds of material in excess of requirements, as, for instance, brass bars from which a number of parts may be made on a machine tool, and which can be worked upon better in full bars. The excess is later returned to the Store, accompanied by a Shop Credit Note, or what is the same thing, a Stores Debit Note, on which is stated the job to be credited.

(d) *Records of Material Issued*.—The Issue Requisitions show the quantity taken, and later, when they reach the Works Office, the quantities of each kind of material are priced, extended, and entered in the Stores Ledger, after which the Materials Abstract is entered up ready for posting to the Cost Ledger Accounts.

The necessary entries on the Stores Bin Cards are made at the time of issue by the storekeeper, and in the Stores Ledger by a clerk in the Cost Office. The totals of the analyses of the figures posted to the Stores Ledger are also posted to the Materials Control Accounts, thus providing for reconciliation with the Financial Accounts.

The Wages Abstract.—The wages paid to the workers will usually be calculated upon gate-times, piece-work tickets, or time-sheets, according to the arrangements in force. Full particulars of the amount paid to each, and the total, are recorded in the Wages Book or Pay-roll arranged departmentally.

An analysis is also made on a Wages Abstract, so that the number of hours and amount chargeable to each job or contract, or expense account, are ascertained. (Fig. 58.) In the case of builders and contractors, this analysis will be compiled from details provided on time-sheets, and the Abstract is usually in sections, according to trades, so that separate totals for each job for each class of work are obtained, *e.g.* bricklayers, plumbers, joiners, etc. The total against each job number is posted to the appropriate Cost Account. (See also p. 463.)

FIG. 58.

No. 32. Week ending February 7, 19...																				
Job No. 90.			Job No. 91.			Job No. 98.			Job No. 100.			R. 13.			N. 31.			SUMMARY.		
Clock No.	Hrs.	Amount.	No.	Hrs.	Amount.	No.	Hrs.	Amount.	No.	Hrs.	Amount.	No.	Hrs.	Amount.	Job No.	Hrs.	Amount.	Cost Led. fol.		
																			£	s.
12	4	£ 8 0	22	5	£ 7 6	12	4	£ 8 0	22	3	£ 10 0	11	8	£ 10 0	90	15	£ 11 11	5		
13	8	16 8	23	1	8 0	13	2	16 0	18	11	16 0	17	3	16 0	91	9	15 0	1		
18	2	5 0			4 0	21	2	4 0	21	2	4 0	21	3	6 0	98	41	4 8	4		
21	1	2 3						2	12	20	0 0	22	40	3 0 0	100	8	17 6	100		
								6	19	6	15 0				R. 13	45	4 10 0	8		
															N. 31	59	1 18 9	1		
	15	1 11 11		9	15 0		44	4 8 0		45	1 19 0		59	4 18 9		180	17 10 3	3		

A portion of a wages abstract sheet. The total shown in the summary column must agree with the direct wages on the pay-roll.
Another form appears on p. 463.

FIG. 59.

STORES MATERIALS ABSTRACT

No. 12, Week ending : February 7, 19...																											
Job No. 90.				Job No. 91.				Job No. 98.				Job No. 100.				R. 13.				N. 31.				SUMMARY.			
L.R. No.	£	s.	d.	L.R. No.	£	s.	d.	L.R. No.	£	s.	d.	L.R. No.	£	s.	d.	L.R. No.	£	s.	d.	£	s.	d.	Job No.	£	s.	d.	Cost Led. fol.
91	4	9	0	93	1	2	0	94	2	1	0	96	8	6	0	98	8	3	0	6	3	0	90	7	9	0	
95	3	9	0	97	3	7	0	98	2	15	0	99	3	2	0	99	5	19	0	6	19	0	91	4	9	0	
												99	1	5	6								98	7	15	0	
												99											100	2	16	0	
																							R. 13	12	2	0	
																							N. 31	47	4	6	

In factories using the job cost method, the hours and amounts chargeable to each job are recorded by one of the methods described in a previous chapter, as, for instance, job clock-cards, job-tickets, piece-work tickets, etc. From these the Wages Abstract is prepared. A separate account of each kind of indirect labour is kept under Expense account numbers.

The total of the Wages Abstract must be agreed with the total of the pay-roll, thus ensuring that in total the charge for wages in the cost accounts will be in agreement with the financial accounts. The totals are posted to the Wages Control Account. (See Ch. XV.)

Posting the Cost Ledger.—The separate totals of materials and wages for each job are then posted to a Cost Ledger Account for the job (see form on pages 191 and 213). The Job or Contract Cost Ledger is often in card or loose-leaf form, a separate card or sheet being used for the cash account instead of the usual book form. The total of each class of indirect labour which cannot be posted direct to the Job Accounts is posted to appropriate Expense Accounts. The indirect labour and indirect material expenses which cannot be charged direct are recovered in the various Job Accounts by a rate on a suitable basis, *e.g.* a rate per direct-labour hour, a percentage on direct wages, etc., as explained in an earlier chapter. Reconciliation of Cost Ledger with the Financial Accounts is effected by means of Control Accounts as described in Ch. XV.

The procedure so far described is alike for both Contract Accounts and for Job Cost Accounts in a factory. The particular features of Contract Accounts will now be considered—the Accounts of a builder being used for illustration. Factory Job Costs will be described in the next Chapter.

CONTRACT COST ACCOUNTS

The Form of Cost Ledger Accounts (Contracts).—For builders and other contractors a suitable ruling for a Contract Account is shown in Fig. 60. For businesses with many small contracts the card form of Contract Cost Ledger is very convenient, as the accounts of completed jobs can be removed to a separate filing cabinet. Other forms appear on pages 213, 214 and 327.

An account is opened for each contract. The exact form of the account will depend upon individual requirements. For instance, the column headed "Wages" in Fig. 60 is often expanded into several columns, a separate one being used for

labourers, bricklayers, joiners, plumbers, painters, etc. In the case of large building contracts it is not unusual to take two pages across the Prime Cost Book for each Contract Account, one page showing the Materials analysed under such headings as the management may require, and the other dealing similarly with wages analysed by trades. The totals are posted on completion of the contract, or, at intervals, to a summary Contract Cost Account, ruled similarly to the Contract Accounts themselves. (Fig. 60.)

The Wages portion of a Prime Cost Book is shown in Fig. 61.

(a) *Materials*.—In the Purchase Analysis Journal direct purchases for particular contracts will be extended into a separate column, and will be debited direct to the contract concerned. The stores materials are analysed in separate columns for joiners', masons', bricklayers', and plumbers' materials, as it is usual to keep separate Stores Accounts for these sections. The totals of these stores materials columns are posted to Stores Accounts in the Nominal Ledger. A separate Stores Ledger is kept on the lines described in a previous chapter.

The issues of materials are debited to the Contract Accounts from the Stores Materials Abstract (Fig. 59), and the grand total of the Abstract is posted to the credit of Stores Control Account in the Nominal Ledger.

(b) *Plant*. The value of plant and tools sent to the site of a contract is debited to the Contract Account, the appropriate Plant Account being credited.*

When the contract is finished, such plant as may be returned to the yard is credited to the contract at its estimated value, usually much depreciated. Some special plant may not be suitable for any other work, as, for instance, wooden templates, and may be sold at scrap price. The price so obtained will be credited to the cost account for the contract. By this procedure each contract bears the depreciation cost of the use of the plant.

(c) *Sub-contracts* are dealt with in the same manner as special direct materials; they are debited to the Contract Account direct from the Purchases Analysis Journal.

(d) *Direct Expenses*.—Disbursements of this kind, e.g. Petty Cash, Plant Hire, etc., are posted direct to the Contract Accounts concerned.

* Plant owned and sent for use for short periods is not charged in this way, but instead an hourly-rate or daily-rate is used, the charge thus depending on the time used. Such a charge will be credited to Plant Depreciation Account, or a Plant Maintenance and Hiring Account.

ount is debited with the running expenses, e.g. fodder, rol, oil, drivers' wages, repairs, depreciation, etc.

Each driver records on his time-sheet the time taken on each and states for which contract. The haulage expense is then culated at a rate per hour, and debited, accordingly, to the pective contracts. Any balance not definitely chargeable to tracts is included in General Operating Expense Account recovery in Works Overheads.

(j) *Specimen Contract Accounts*.—Under the procedure de-ribed above the Contract Ledger forms an integral part of the ncial double-entry accounts. The control accounts and al accounts are exemplified below.

CONTRACT CONTROL ACCOUNTS

1. Stores Materials Account

Cr.

19...			£	s.	d.	19...			£	s.	d.
1	To Balance on hand	b/d.	860	0	0	Jan. 31	By Issues to Con-	A6	410	0	0
31	" Purchases	J6	710	0	0	Feb. 28	" " "	AS	270	0	0
28	" "	J9	760	0	0	Mar. 31	" Jobbing A/c.	AS	820	0	0
31	" "	J11	970	0	0	"	" Issues to Con-	A10	350	0	0
						"	" Issues to Job-	A10	760	0	0
						"	" Stock on hand	c/d.	690	0	0
			<u>£3300</u>	<u>0</u>	<u>0</u>				<u>£3300</u>	<u>0</u>	<u>0</u>

2. Wages Account

(or a separate account for each department, Joiners, etc.)

Cr.

19...			£	s.	d.	19...			£	s.	d.
31	To Cash	81	1590	0	0	Mar. 31	By Sundry Con-	J12	2460	0	0
28	" "	90	1630	0	0	"	" Stonemasons		460	0	0
31	" "	98	1720	0	0	"	" Shop A/c.		610	0	0
						"	" Joiners Shop		790	0	0
						"	" Jobbing (Join-				
						"	" ers) Shop A/c.		620	0	0
						"	" Expense Con-				
						"	" trol A/c. (In-				
						"	" direct Labour)				
			<u>£4940</u>	<u>0</u>	<u>0</u>				<u>£4940</u>	<u>0</u>	<u>0</u>

3. Stonemasons' Shop Account

(a similar account for Joiners, etc.)

Cr.

19...			£	s.	d.	19...			£	s.	d.
1	To Balance	b/d.	120	0	0	Mar. 31	By Sundry Con-	J12	600	0	0
31	" Wages	98	460	0	0	"	" tracts A/cs.	J13	395	0	0
	" Stores Mater-	1	290	0	0	"	" Jobbing A/c.		195	0	0
	" als					"	" Balance, Work	c/d.			
	" Expenses Al-	5	320	0	0	"	" in Progress				
	" location								<u>£1190</u>	<u>0</u>	<u>0</u>
			<u>£1190</u>	<u>0</u>	<u>0</u>						

contract, a prudent course to provide against possible losses before completion from any of various possible causes.

Contract No. 86.

	£
Labour on Site	40,500
Materials direct to Site less returns	42,000
do. from Store and Workshops	8,120
Plant sent to Site	6,200
Direct Expenses	2,300
General Overhead Expense apportioned to this contract	3,710
Materials on hand 30th June	630
Wages accrued at 30th June	780
Direct Expenses accrued	160
Valuation of Plant 30th June	4,990
Work not yet certified, at Cost	1,650
Amount certified by Architects	110,000
Cash received on account	90,000
Contract Price for Completed Contract	125,000

Prepare the Contract Accounts to show the position at 30th June, retaining an adequate reserve against possible losses before completion of the contract.

The details of the expenditure would be posted to a Contract Ledger Account in the form shown on page 191, and the position of the Contract may be shown as follows :

Dr.			Contract No. 86.			Cr.		
19		£	19		£			
June 30	To Materials direct	42,000	June 30	By Material on hand c/d.	630			
"	" Other Materials	8,120	"	" Plant Valuation c/d.	4,990			
"	" Wages	40,500	"	" Balance c/d.	98,150			
"	" Direct Expenses	2,300						
"	" Plant	6,200						
"	" General Overhead	3,710						
"	" Wages Accrued c/d.	780						
"	" Direct Expenses Accrued c/d.	160						
		<u>£103,770</u>						<u>£103,770</u>
June 30	To Balance b/d.	98,150	June 30	By Work Certified	110,000			
"	" ½ Profit to Profit & Loss Account *	9,000	"	" Work done not yet Certified c/d.	1,650			
"	" Balance of Profit c/d.	4,500						
		<u>£111,650</u>						<u>£111,650</u>
July 1	To Materials on hand b/d.	630	July 1	By Profit b/d.	4,500			
"	" Plant b/d.	4,990	"	" Wages b/d.	780			
"	" Work not Certified b/d.	1,650	"	" Direct Expenses b/d.	160			

* Alternatively, instead of taking ½ of £13,500 profit, a more conservative sum could be calculated thus :

$$\text{Cash Received } \frac{£ 90,000}{110,000} \times 9,000, \text{ i.e. } \frac{9}{11} \times 9,000, \text{ say } £7,364,$$

which would increase the profit reserve carried down to £6,136.

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Dr.		CONTRACTEE'S ACCOUNT		Cr.	
19			19		
June 30	To Contract 55.		June 30	By Cash	20,000
	Architect's Certificate .	110,000	"	" Balance c/d. : :	20,000
		<u>£110,000</u>			<u>£110,000</u>
July 1	To Balance b/d. . . .	20,000			

[“Time and Lime” Contracts, and “Target” Contracts are described on page 22.]

In the next chapter is described the general procedure for job costs in factories. The reference therein to mechanical aids for costing where detail is considerable may be applicable to Contract Accounts in suitable cases. The operation of various forms of control accounts for interlocking or reconciliation with the Financial Accounts is described in Chapter XV.

year 1929 that proportion of the total which corresponded to the work certified by December 31.

The estimate was as follows :

- (a) That the contract would be completed by September 30, 1930.
- (b) That the wages on the contract in 1930 would amount to £71,500.
- (c) That the cost of stores and materials required in addition to those in stock on December 31, 1929, would be £68,600 and that the further contract expenses would amount to £6,000.
- (d) That a further £25,000 would have to be laid out on plant and tools and that the residual value of plant and tools on September 30, 1930, would be £3,000.
- (e) That establishment charges would cost the same sum per month as in 1929.
- (f) That 2½ per cent. of the total cost of the contract would be due to defects, temporary maintenance, and contingencies.

Prepare Contract, Stores and Materials and Plant Accounts for the year ended December 31, 1929, and show your calculation of the amount credited to Profit and Loss Account for that year. Ignore shillings and pence.—*Institute of Chartered Accountants (Final)*.

5. From the following particulars relating to Electric Lighting Installation prepare a Cost Ledger account tabulated in order to show Materials, Wages, and Indirect Charges, in separate columns :

Contract No. 50 Cavendish Mansions,
(Estimate Book folio 5, Personal Ledger folio 109.)

19			£	s.	d.
Jan. 21	Requisition 1131, Cable (1 mile)	.	36	0	0
Feb. 10	„ D 40, Fuse Cases (six)	.	27	0	0
„ 10	„ D 50, Dynamo	.	71	5	0
„ 11	Tubing (1,300 feet)	.	7	6	0
„ 11	Bends (3 doz.)	.	1	10	0
Mar. 22	Cable (220 yds.)	.	11	0	0
Apl. 26	Cr. Cable returned (110 yds.)	.	2	0	0
Mar. 28	Wages :—				
	Department A	.	30	0	0
	Department B	.	28	0	0
	Fitters	.	300	0	0

Indirect Charges :

- (a) Department A—
30 per cent. on Wages.
- (b) Department B—
25 per cent. on Wages.
- (c) Fitters—
20 per cent. on Wages.

Distribution Charges :

10 per cent. on Shop cost.

Society of Incorporated Accountants and Auditors (Final).

6. Assuming a Contract Ledger to be ruled in the following columns :

Materials, Plant, Wages, Establishment Charges, Other Expenses,

enter under its appropriate heading the under-mentioned items of expenditure, and state how you would deal with returns of Materials and Plant :

Prepare a Stores Ledger Account in relation to these Goods, adding such reference columns and other particulars as you think necessary and bringing down the balances as at April 30th. The market prices of the three sizes on that date were 3/11ths £26 per mile, 2/9th £28 per mile, and 1/9th £15 10s. per mile.

11. Outline a Costing Scheme by the Card System suitable for a General Contractor's business, and indicate the advantages of the system for this particular trade.—*Society of Incorporated Accountants and Auditors (Final)*.

12. The following are a week's transactions in respect of a building contract, No. 25 :

Wages paid	£560
Bricks ordered for the job and delivered direct	200
Materials delivered from stock	75
Cash received on Architect's Certificate	600
Joinery delivered from Joinery Shop	370
Plant delivered from Yard	50
Cash payment on account to sub-contractor for plastering	200
Plant returned to Yard	20

Show by Journal entries how these transactions will be recorded in the Cost Ledger, and prepare an interim Contract Account with the entries made.—*Society of Incorporated Accountants and Auditors (Final)*.

13. Using the figures given in the previous question and assuming any others you may find necessary, draw up a statement showing how you would value the uncompleted contract at a balancing date. Add notes giving reasons for your workings.—*Society of Incorporated Accountants and Auditors (Final)*.

14. A Building Contractor's financial year ends on 30th June, 1933. The following particulars relate to Contract No. 99, which is uncompleted at that date, viz. :—

Wages incurred to 30th June, 1933	£5,400
Materials purchased for contract	7,300
Plant	2,000
Direct Expenses to 30th June, 1933	800
Materials in hand as at 30th June, 1933	1,000
Value of Plant	1,700
Work certified by Architect	13,900
Cost of Work not yet certified	2,200
Agreed Contract Price	25,000
Cash received to account	12,500
Wages accrued due at 30th June, 1933	200
Direct Expenses	100
Establishment Charges (proportion applicable to Contract No. 99 to 30th June, 1933)	1,200

Prepare Contract Account, crediting Profit and Loss Account with two-thirds of profit received, and carrying forward one-third as a reserve.—*Association of Certified and Corporate Accountants (Final)*.

CHAPTER XIV

FACTORY JOB COSTING

The Works Order Number.—The costs are collected and recorded under the works order number, a separate cost account being set up for each number. By using a well-arranged numbering scheme, work of different categories, and work done in various departments, can be readily identified.

The method of numbering, and some of the procedure varies according to whether the order is for

- (a) Repetition work.
- (b) Work involving sectional operations, or the making of components for assembly.
- (c) A simple straight job.

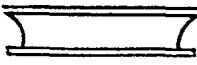

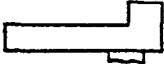
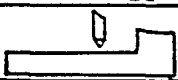

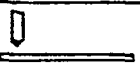


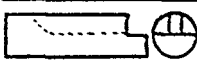

When an order is received, the Works Office allots a works order number to it. If necessary, the work will be divided into sections, and, in this case, a master order number would be given to the order as a whole, and sub-section order numbers to the parts composing it, *e.g.* sub-numbers for components.

In some works this is an elaborate process, often involving the setting up of many operations, for each of which the Planning and Rate-fixing Departments decide the extent of each operation, and the time to be allowed for performing each.

For repetition work the Planning Department decides how the work is to be split up, draws up a schedule of jobs, and identifies each job, or operation, by a distinguishing number, or index letter. An index number, letter, or symbol combined with an operation number, is often used with great advantage. The example in Fig. 62 shows how a schedule of operations can be indexed; in this case, the operations for making a Clipper Card Sheath for a Gledhill-Brook time recorder.

The Works Order.—A Works Order, or ticket bearing the order number, is issued to each foreman who will be responsible for any of the work, *e.g.* machine-shop, fitters, assembly, inspection, etc. Sometimes a duplicate of the order is sent to the Stores, so that the necessary materials, small tools, and jigs

Clipper Card Sheath:

Illustration	Letter	Description
	R.C.A.	Milling Card Sheath Castings.
	R.C.B.	Drilling to fig.
	R.C.C.	Mouthpieces, Drill + Grind
	R.C.D.	Butter Holder, Boring + Turning
	R.C.D.	Butter Holder, Machining
	R.C.D.	Drilling to fig. + Tapping
	R.C.E.	Butter Plates, Punching
	R.C.E.	Blatten Drill + Tap
	R.C.F.	Butters, Machining
	R.C.F. ²	File to fig.
	R.C.F. ³	Grinding after Hardening.
	R.C.G.	Butter Shanks, Cut off, Straighten + Drill
	R.C.G.	Machining
Castings.	R.C.H.	Brass Top Plate Making.
Castings.	R.C.H.	Bottom Plate.
	R.C.I.	Aligning Stud, Make in Bampton.
	R.C.J.	Springs for Card Butters.
	R.C.K.	Assembling Clipper Card Sheath Complete

required may be issued. This saves delay, which may occur if the writing of a Stores Requisition is left to the foreman; it also avoids the risk of ordering material in excess of requirements. This procedure ensures that the Cost Office has all the preliminary information before the work is commenced.

If it is planned that the order accompanies the work until complete, being then passed to the Cost Office when the finished articles are taken to the Finished Store, the Cost Office is sure that the order is completed, and can proceed to make up the cost.

The time of commencing may be written on the work-ticket, but in very many factories to-day special time-recording instruments are used, as already described in the chapter dealing with time booking methods.

Time Control of Operations.—When there are a number of operations, a useful plan is to issue an operation card, which details the number of the job, the time allowed for each operation (based on time “studies”), jigs, and drills required, and such other information as may be necessary. A specimen is shown in Fig. 63.

Recording Labour and Machine Time.—The time spent on each job must be taken both of direct labour and of machines. These are necessary for ensuring the correct charging of (a) direct labour against the job, and (b) the fair proportion of Overhead (or, as it is often misnamed, Oncost).

In nearly all efficient costing systems, the time spent on the job is the foundation upon which the costing is built. It is most important that these time records should be accurate, and, for this purpose, the time recorders already described are invaluable. As the procedure has been detailed already in Ch. VII, it is only necessary to mention the five methods which are commonly used, the circumstances in any particular factory determining which is the most suitable :

System 1. One clock card per man for weekly time, and one card per job for each man for costing purposes.

System 2. One card per man for weekly time and job time combined, together with total time for each job on the same card. Unfinished jobs are carried forward in spaces provided at the foot to the next week's time and job card.

System 3. One card per man for weekly time and job time combined, and a master card, or cost sheet, for all men's time on each job.

System 4. One card for each job. Time "In" and "Out," and "On" and "Off," is clocked on the job card, and the total of each card is transferred to a summary card, no weekly card being used by the man.

FIG. 63.

CLIPPER CARD SHEATH.					
OPERATION CARD.		INDEX LETTER OF JOB	2 C A		
QUANTITY		EACH.	30	60	120
TIME NOT TO EXCEED:—		$\frac{1}{2}$ Hour	15 Lrs.	30 Lrs.	60 Lrs.
JIGS REQUIRED. <i>Jigs 461 ABCDEFGH</i>		DRILLS REQUIRED <i>No 21 Drill</i> <i>$\frac{3}{16}$" Tap</i>		Scheduled Time.	
Operations	<i>Castings to be dipped in acid before given out for machining</i>				Time each
1	<i>Preparation & set up to milling feature 461</i>				10 mins
2	<i>Drill to Sp. No. 461A, 5 No 21 Holes Burr.</i>				4 "
3	<i>Tap 5 No 21 Holes with $\frac{3}{16}$" Tap</i>				15 "
4	<i>Mount feature 461 on hollow table No. 1. Fasten card sheet casting with 5 screws supplied. Machine front of casting to sample 461C. Recess for card = .055" Deep. Wide slot must be in centre of casting</i>				6 "
5	<i>Tap Sange 461D, & Cam 461E, on hollow table No 1. Hold finished edge of casting against Sange 461 D, with CAM 461E, then clamp to table with clamps 461F & 461G. Now machine top end of casting, square with card slot. Only pass clean up. File off all Burrs.</i>				3 "
6	<i>Hold on same way as last operation. Machine seating for cutter holder to be .312" \pm or 3 thick. Place packing 461H under seating to prevent spring when cutting.</i>				2 $\frac{1}{2}$ "
7	<i>Inspection after milling.</i>				3 "
<i>Total</i>					30 "

System 5. For recording machine time in the case of automatic machines, one card per machine shows both productive and idle time, with a summary of job times at the foot. The man in charge of a group of machines uses a weekly clock card as well.

Standing Order Numbers.—In addition to production orders, there are many jobs in every factory which are done in connection with Service Departments, or are in the nature of an expense to the business. These must be scheduled and given a standing order number as described in Ch. IX. Items of cost are charged against these numbers in the same way as for works orders. There are several methods for collecting the labour time in Service Departments :

(1) The engineer's or foreman's starting ticket, or job ticket, detailing the job, is given to the workman, who, on starting, enters the time. Usually, the standing order number is already inserted; if not, this will be done by the foreman on passing the job. Material is requisitioned under the standing order number. On completion, the job ticket is passed to the Cost Office.

(2) Another procedure, using time-recorders, is as follows: The job ticket (Fig. 29), bearing the standing order number, is given to the workman, who "clocks" on a time card the time of starting. The standing order number is entered against the time on the clock card, which is then placed in the rack under the workman's number. The details on the cards so used by the men are then entered on a summary sheet, daily or weekly, a separate sheet (Fig. 64) being used for each standing order number.

(3) A separate clock card for each standing order number is kept in a rack. When a man does work on a particular order number, he "clocks" on the appropriate card, entering his number against the time. At the end of each week, the cards are ruled off, and the totals posted to the proper Expense Account. The cards can thus be used continuously until full, and may last several weeks.

Idle or Waste Time Standing Order No.—This is used for

- (1) Time waiting for jobs, or materials.
- (2) Time waiting for foreman.
- (3) Waiting time, owing to breakdown of plant, etc.

FIG. 64.

UPKEEP OF SHOP TOOLS.

K.30.

	Check No.	Men's Time.							Boys and Girls' Time							Total Hours	Rate	Labour Cost			Machine Rate				
		Th. F. S. M. Tu. W.							Th. F. S. M. Tu. W.									£	s.	d.	£	s.	d.		
Johnson	140		3		7			2								12	10 ^p								
Smith	84	4		1		2										7	6 ^p	3	6						
Lomkins	260			5				4								9	9								
Watkins	220	3		2		4										9	10	7	6						
Heelivell	160		1 ¹ / ₂		3			7								11 ¹ / ₂	11								
Jones	310	4		5		1										10	11	10							
Thompson	197		2		7			1 ¹ / ₂								10 ¹ / ₂	11								
Macpherson	360	1		7		6										14	9	10	6						
Bryce	18		1		3											4	8	2	8						
O'Grady	110	2		6		1		3								12	11	11							
Pearson	365															16	4	5	4						
Williams	367															8	3								
Week's TOTAL																		44	11	3	1	19	6	10	

These times should be recorded on the time-sheets, or may be "clocked" on appropriate clock-cards. The cost of Idle Facilities must not be included here; it is best written off to Profit and Loss Account.

Time on Replacing Rejected Work.—When it is decided to make up the quantity of parts to the number originally ordered, of which some have been spoiled, or rejected, the time-card for the job will be re-stamped, thus getting a record of the extra time taken. A report of spoilt work forms the basis of a charge to the appropriate expense number.

Overtime Expense.—When the overtime is worked on a special job, say outside the works, or when it is due to the special desire of a customer to have the job completed or rushed through within the time specified, the extra payment for overtime is legitimately charged to the job as direct labour.

When, however, the overtime is for the purpose of generally increasing the output of the factory, *e.g.* to keep up with stock requirements or orders generally, the cost of the overtime is charged to Works Overhead Expense Account. A standing order number is provided for this.

The Pay-Roll and Wages Analysis.—The pay-roll is made up from the gate clock cards and piece-work tickets. If clock cards are not used, the entries are made from time-sheets. When a premium bonus, or other output or efficiency bonus, is paid, an extra column will be provided for inclusion of these amounts. (See Fig. 65.)

In the Cost Office the wages are dissected on Analysis Sheets, so that correct allocation of direct wages to jobs is made, and of indirect wages to the appropriate Expense and Service Departments Accounts. (See Fig. 66.) Statistical data regarding labour and departmental totals will also be prepared. (See Fig. 67.)

The Cost Office Analysis must agree in total with the total shown on the wages-sheet, thus ensuring that the Cost Accounts will be in complete agreement with the wages total in the Financial Accounts. This is a most important point. Reference to the totals in Figs. 65, 66 and 67 will demonstrate such agreement.

Stores Materials.—The materials issued to jobs against requisitions, and materials purchased for specific jobs, are debited to the appropriate Cost Accounts, as described in the preceding chapter and Ch. V.

Tool Room and Tool Store Procedure.—The careful selection, and the making and maintenance, of tools for manufacturing

FACTORY PAY-ROLL

Week Ending:

Clock No.	Employer's Insurance.			Rate.			DEDUCTIONS.								Hours.	Gross Day Wage.		Piece-work Bonus.		Gross Day Wage P.W. Bonus.		Nett Wages paid out.									
	Employer's Insurance.			Rate.			Mutual Aid.		Sports Club.		Employee's Insurance.		Gross Day Wage.			Piece-work Bonus.		Gross Day Wage P.W. Bonus.		Nett Wages paid out.											
							£	s.	d.	£	s.	d.										£	s.	d.	£	s.	d.				
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.										
Totals	40	7	0				3	5	0		6	2	9			38	6	0	20,539-8	797	16	1	73	7	3	871	3	4	823	9	7

A column for "Pay as You Earn" Income Tax deductions may be included, but this will not affect analysis for costing purposes.

FIG. 60.

ANALYSIS OF INDIRECT WAGES AND DEPARTMENTS CHARGED

Week ended 5th May, 19.....

No.	Department. Name.	Total Indirect Charged.		Tool Making and Re- pairing.		Repairs.		Replacements.		Overhaul.		Super- vision (Charge Hands).		Labour- ing.		Inspection.		Added Time for Over- time.		Idle Time.		Service (separ- ately analysed).	
		£	s. d.	£	s. d.	£	s. d.	£	s. d.	£	s. d.	£	s. d.	£	s. d.	£	s. d.	£	s. d.	£	s. d.	£	s. d.
410	Foundry	10	12 0	6	0 0	0	0 0	1	0 0	1	0 0	2	1 0	1	0 0	0	0 0	0	0 0	0	0 0	0	0 0
411	Plating	2	18 0	17	0 0	0	0 0	1	0 0	1	0 0	1	0 0	1	0 0	0	0 0	0	0 0	0	0 0	0	0 0
412	Engineering	20	10 0	1	0 0	0	0 0	1	0 0	1	0 0	1	0 0	1	0 0	0	0 0	0	0 0	0	0 0	0	0 0
413	Polishing	1	2 4	2	0 0	0	0 0	1	0 0	1	0 0	1	0 0	1	0 0	0	0 0	0	0 0	0	0 0	0	0 0
414	Machine (A)	11	2 3	2	0 0	0	0 0	1	0 0	1	0 0	1	0 0	1	0 0	0	0 0	0	0 0	0	0 0	0	0 0
415	Whirling	0	0 0	2	0 0	0	0 0	1	0 0	1	0 0	1	0 0	1	0 0	0	0 0	0	0 0	0	0 0	0	0 0
416	Fitters	35	0 4	1	0 0	0	0 0	1	0 0	1	0 0	1	0 0	1	0 0	0	0 0	0	0 0	0	0 0	0	0 0
417	Machine (B)	30	8 10	1	0 0	0	0 0	1	0 0	1	0 0	1	0 0	1	0 0	0	0 0	0	0 0	0	0 0	0	0 0
418	Total Manufg. Dept's.	£234	0 5	£31	2 7	£7	1 3	£10	8 1	£33	8 0	£10	8 0	£10	8 0	£10	8 0	£5	1 10	£5	8 8	£	s. d.
401	Progress	51	13 3	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0
402	Heating Engineering	10	1 4	1	8 11	0	0 0	1	11 1	1	12 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0
403	Drawing Office	10	10 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0
404	Inspection	8	11 7	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0
405	Maintenance	33	18 6	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0
412	Despatch	13	12 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0
418	General Office	20	17 10	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0
419	Stores	40	17 11	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0
420	Experimental	42	10 8	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0	0	0 0
421	Total Non-Manufg. Depts.	£251	0 0	£7	3 10	£32	15 11	£20	10 10	£16	13 1	£10	6 11	£10	6 11	£4	11 0	£8	15 0	£3	10 8	£	s. d.
422	Gross Totals	£485	0 5	£38	7 7	£39	0 0	£30	7 11	£49	0 10	£20	11 2	£20	11 2	£5	13 4	£13	17 7	£6	8 8	£	s. d.

purposes are of great importance. In connection with the organisation dealing with tools there are three divisions: (a) Manufacturing, (b) Maintenance and Inspection. (c) Storage and Issue.

Tool Manufacture.—The making of tools for production may be costed by the job costing method described in this chapter, the cost being charged to Standing Order Numbers.

Tool Storage and Issue.—The tool stock can be conveniently recorded by the use of the bin card procedure already described. If written requisitions are used, they should be made out in triplicate; one copy is kept by the workman, one in a file at the bin in numerical order of the recipients, and one in a file on the tool-store clerk's desk arranged numerically according to tool nomenclature. When a tool is returned, the requisitions are withdrawn from the files and completed as to time and date of return for analysis purposes.

An alternative and common method is to issue brass checks to the workmen, numbered according to their clock numbers. A check is given in exchange for a tool, and is hung on a peg on the bin. Each tool bin has checks also, bearing the symbol and number of the tools. When the workman's check is placed by the bin, a tool check is removed to correspond, and is hung on a control board under the workman's number. Track of the tools is therefore easily kept. This method provides none of the useful data obtainable from the requisition note procedure, and therefore a combination of both methods is sometimes used.

Tools Returned.—These are examined and reconditioned before being replaced, and the cost (Fig. 64) is charged to Upkeep of Tools Expense Account.

The Allocation of Tool Expense.—All the expenses of running the Tool Room and Tool Store are collated and apportioned as overhead to machine departments, except for the value of tools capitalised. The basis of shop machine hours is useful for the purpose. Regard must be had to the fact that Tools are made for (1) Tool Room use, (2) other centres. (3) for sale.

Overhead Expenses—Manufacturing.—This group of expenses is very frequently termed Works Oncost, but Production (or Factory) Overhead is the correct description.

Factory Overhead, as manufacturing expenses are properly termed, should be apportioned to:

(a) Machine-hour rates.

(b) Direct Labour-hour rates (or other departmental rates).

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incurred. In other words, it is necessary to test whether the machine-hour rates and labour-hour rates (or other bases used) do, in fact, "recover" the expenses incurred.

FIG. 70.

ALTERNATIVE FORM OF JOB COST LEDGER ACCOUNT

Name of Customer or No. 23/276.

Works Order No. 6327

Date of Order 30/12/19..

Description: 1. C.I. Spur wheel.

Date	Clock No.	OPERATION	Class	TIME							Total Hours	Rate	WAGE			BONUS	MACHINE RATE			COST				
				M.	T	W.	Th.	F.	S.	Sa.			£	s.	d.		£	s.	d.	Mach. No.	Hours	Rate	£	s.	d.
19..																								
Jan 12	1	Box 1 Yarn		6	8	8	8					30	44	1	6	06	6	6	82	30	9	1	2	6
Jan 12	2	Cutting						8	5															
✓ 19				8	8	8	4					41	40	1	10	11½	5	87	115	36	7	1	16	
✓ 19	3	Keyways						2				2	39	1	5		4	43	2	6				1
														2 18 44			12 63			2 19 6				

Date	Reg. No.	MATERIALS			WEIGHT				Quant. Lbs.	Rate				SUMMARY					
		DETAILS			T	C	Q	lbs.			£	s.	d.				£	s.	d.
Jan 2	2764	Cast Iron			16	2	12	1	18	14	17	2		Wage	—	—	2	18	45
													Bonus	—	—	—	—	12 63	
													Machine Rate	—	—	2	19	6	
													Other Rates	—	—	—	—	—	
													Overhead	—	—	3	5	0	
																9	15	57	
													Material	—	—	14	17	2	
													.. 10 %	—	—	1	9	88	
																26	2	4	
													Selling Expenses	—	—	4	—	—	
													Profit	—	—	3	—	—	
													Selling Price	—	—	33	2	4	

Assume that the actual overhead expense incurred for the year was £13,000. On analysis, suppose £7,000 is allocated to Machine Shops, and £6,000 to non-machine work. Dividing by thirteen to find the actual charge for every four-weekly period, we have £540 against Machine Shops, and £460 against non-machine work.

On taking a summary of the hours, and "recoveries" of Overhead, charged in all the various Job Accounts, we find the total "recoveries" of the first four weeks are :

Recoveries by machine-hour rates . . .	£555
„ „ labour-hour rates . . .	466
	<u>£1,021</u>

FIG. 71. SCHEDULE COMPARING OVERHEAD RECOVERED WITH ACTUAL

MACHINE HOURLY RATES.

	1st WEEK			2nd WEEK			3rd WEEK			4th WEEK		
	Prod. Hrs.	Rate £ s. d.	£ s. d.	Prod. Hrs.	Rate £ s. d.	£ s. d.	Prod. Hrs.	Rate £ s. d.	£ s. d.	Prod. Hrs.	Rate £ s. d.	£ s. d.
1 Planning M/c	50	3/6	6 18									
2 ditto	80	1/7	5									
10 Lathe I	300	1/15										
6 do II	300	9 11 5										
3 Milling M/c I	180	2/18										
5 - II	240	1/6 18										
4 - III	160	1/3 10										
3 Capstan I	180	1/3 9 7 6										
2 - II	80	9 3										
6 - III	240	6 6										
4 Automatic I	200	1/6 15										
12 Drilling M/c I	480	9 18										
20 - II	400	6 10										
			44 17 6			148 10			133			29 12 6 555 0 0

DEPARTMENTAL HOURLY RATES.

	1st WEEK			2nd WEEK			3rd WEEK			4th WEEK		
	Prod. Hrs.	Rate £ s. d.	£ s. d.	Prod. Hrs.	Rate £ s. d.	£ s. d.	Prod. Hrs.	Rate £ s. d.	£ s. d.	Prod. Hrs.	Rate £ s. d.	£ s. d.
Department A	2400	3	30									
B	1000	4	16 17 4									
C	2000	3	25									
E	900	2	7 10									
F	1000	5	20 16 8									
G	1500	2	12 10									
H	600	3	7 10									
			120 0 0			172 10			118			115 10 166 0
	9400											

proving that the rates used are sufficient to cover the Overhead. The excess is not large, so no alteration in the rates is necessary. The excess is transferred to Overhead Adjust-

Office Oncost to be charged at 5 per cent. on Works Cost.
The Selling Price of the machine erected on site was £4,350.

State how the double entry in relation to these items is completed in the Cost Ledger.—*Society of Incorporated Accountants and Auditors (Inter.)*.

5. What is understood by the terms :

- (a) Premium Bonus System of Wage Payment; (b) Job Tickets;
(c) Bin Card; (d) Production Order; (e) Purchase Requisition; (f) Machine Rates?

Society of Incorporated Accountants and Auditors (Final).

6. Describe fully a costing system you would recommend for a motor garage with repair shop, petrol pumps, lock-up sheds for cars, and sales of motor accessories.—*Institute of Cost and Works Accountants (Final)*.

7. In a job order business materials are used in all sorts of quantities. How would you ensure the individual job being duly debited with the cost and what method would you suggest to prove this?—*Institute of Cost and Works Accountants (Inter.)*.

8. An agent for a manufacturer utilises large stores and has a workshop where parts are altered to suit customers' requirements. Sales are on a commission basis, out of which the agent has to meet his own warehouse expenses. Set out a suitable system to arrive at costs.—*Institute of Cost and Works Accountants (Final)*.

9. Draw up a cost statement for a product with which you are familiar, showing, with suitable figures, labour, materials, and charges on machine-hour basis. What other expenses would you expect to add in order to complete the cost statement?—*Institute of Cost and Works Accountants (Inter.)*.

10. Select one of the following and set out a form of final cost, showing material, labour, and overheads :

- (1) Mechanical unit (steam, gas, or electric);
- (2) Complete building (say, small house);
- (3) Box of "lead soldiers";
- (4) Bottle of fruit in syrup;
- (5) Motor chassis, ready for body;
- (6) Complete edition of a book, ready for delivery.

Institute of Cost and Works Accountants (Inter.).

11. Set out a complete form of cost for large non-repetition units of output showing as much detail as possible, with departmental establishment charges.—*Institute of Cost and Works Accountants (Final)*.

12. Give ruling of a cost card suitable for any manufacturing business with which you are familiar, and detail the records from which it would be written up.—*Society of Incorporated Accountants and Auditors (Inter.)*.

13. Explain the relationship existing between the Stores Ledger, Cost Ledger, and Stock Ledger on the one hand, and the Impersonal Ledger and Cash Book on the other, in a factory where costing records are reconciled with the financial books.

Give the Journal entries illustrating the principles of double entry cost accounting in respect of :

- (a) The payment of wages.
- (b) The allocation of oncost.
- (c) The issue of goods from stores to a production order.
- (d) The transfer of finished goods to stock.

Society of Incorporated Accountants and Auditors (Final).

14. Discuss the relative advantages and disadvantages of : (a) Bound, (b) Loose-leaf, and (c) Card, Records for costing purposes.—*Incorporated Accountants (Final)*.

15. Calculate the cost of Job No. 99, which is executed by three departments of a factory.

Productive Wages amounted to :—

Departments, X, £100 (900 hours); Y, £150 (1,500 hours); Z, £70 (600 hours).

Materials used amounted to :—

Departments, X, £150; Y, £140; Z, £50.

Works Oncost is calculated per productive labour hour, and Administration Oncost as a percentage of Works Cost.

The figures for the past year for the three departments are as follows :—

	Dept. X.	Dept. Y.	Dept. Z.
Productive Wages	£2,000	£1,600	£2,400
	(24,000 hrs.)	(18,000 hrs.)	(26,400 hrs.)
Materials	£1,900	£1,450	£2,000
Works Expenses	1,600	1,350	2,200
Administration Expenses	605	440	825

Association of Certified and Corporate Accountants (Final).

16. Gadgets, Ltd., manufacture various standard articles. The costs of Article No. 17 are as follows :—

	£	s.	d.
Materials used	9	0	0
Direct Wages	6	0	0
Direct Charges	1	0	0
Prime Cost	£16	0	0
Works Oncost (150 per cent. on Direct Wages)	9	0	0
Works Cost	£25	0	0
Office Oncost (10 per cent. on Works Cost)	2	10	0
Cost of Production	£27	10	0
Selling Oncost (rate per article)	5	10	0
Cost of Sales	33	0	0
Net Profit	5	0	0
Usual Selling Price	£38	0	0

The manufacturers are offered a Contract to supply 100 articles at the price of £25 each.

In what circumstances would it be advantageous to accept this contract? Give reasons for your answer.

Works Expenses are 70 per cent. fixed and 30 per cent. fluctuating with production.

Office Expenses may be considered as constant irrespective of production.

Selling Expenses are 50 per cent. fixed and 50 per cent. fluctuating with Sales.—*Association of Certified and Corporate Accountants (Final)*.

17. From the following information prepare the Contract Account in the Cost Ledger with a clear indication as to the completion of the double entry in relation to each item.

ciliation of the two sets of accounts, and not infrequently provides better information for the management in the financial records.

The Main Cost Control Account starts with the balances brought forward from the previous month. The monthly totals, preferably under the various headings in the Financial Manufacturing Account, are then posted from schedules prepared, as shown in Fig. 81. The sectional control accounts are debited with corresponding figures.

The Cost Accounts must be reconciled to the above figure of profit. How this is done is shown in Fig. 86.

The sectional control accounts are as follows :

FIG. 82.

STORES MATERIALS CONTROL ACCOUNT

Dr.					Cr.				
19...			£	s. d.	19...		£	s. d.	
Feb. 1	To Balance (opening stock brought down)	b/d.	781	0 0	Feb. 28	By Issues (less Returns) to work in Progress A/c.*	A2	922	15 0
" 28	" Purchases (less Returns)	S2	620	0 0	"	" Deficits in Stock †	J4	24	2 0
"	" Components made.	J4	210	3 4	"	" Balance: Stock in Hand	c/d.	664	6 4
			<u>£1611</u>	<u>3 4</u>				<u>£1611</u>	<u>3 4</u>
19...									
Mar. 1	To Balance	b/d.	664	6 4					

* For each shop, but shown here in total. If materials have been issued to a Service Department, e.g. Tool Maintenance, additional credit item would appear and the corresponding debit in the Service Department Control Account on the lines of Fig. 85.

† If a surplus, this adjusting entry would appear on the debit side.

Other accounts for work in progress, finished stock, and departments are similarly written up.

The general reconciliation with the profit shown in the Main Cost Control Account, which corresponds with that in the Finan-

FIG. 83.

WAGES CONTROL ACCOUNT

Dr.					Cr.				
19...			£	s. d.	19...		£	s. d.	
Feb. 7	To Direct Wages	S5	170	0 0	Feb. 28	By Work in Progress*	J5	545	0 0
" 14	" Indirect "	S6	71	0 0	"	" Service Depts.*	"	163	0 0
" 14	" Direct "	S6	170	0 0	"	" Factory Overhead	"	214	0 0
" 21	" Indirect "	S7	38	0 0					
" 21	" Direct "	S7	178	0 0					
" 28	" Indirect "	S8	52	0 0					
" 28	" Direct "	S8	190	0 0					
"	" Indirect "	"	53	0 0					
			<u>£922</u>	<u>0 0</u>				<u>£922</u>	<u>0 0</u>

* Each shop separately detailed.

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Opening and Closing balances were :

		£	s.	d.
Feb. 1.	Stores Materials on hand	2700	0	0
	Finished Stock " "	2550	0	0
"	Work in Progress :			
	Materials	675	0	0
	Labour	615	0	0
	Overhead	210	0	0
"	General Ledger Adjustment A/c.	6750	0	0
Feb. 28.	Stores Materials	2482	19	0
"	Finished Stock	2706	0	0
"	Work in Progress :			
	Materials	697	1	0
	Labour	630	0	0
	Overhead	216	0	0

FIG. 87.

THE CONTROL ACCOUNTS IN THE COST LEDGER

Stores Materials Control Account

Dr.				Cr.			
		£	s. d.			£	s. d.
19...				19...			
Feb. 1	To Balance	2700	0 0	Feb. 28	By Work in Progress A/c. (issues)	2670	0 0
" 28	" Gen. Led. Adj. A/c. (purchases)	2460	0 0	"	" Shortage adjustment transferred to Factory Overhead A/c.	7	1 0
				"	" Stock on Hand	2482	19 0
		<u>£5160</u>	<u>0 0</u>			<u>£5160</u>	<u>0 0</u>
19...							
Mar. 1	To Balance	2482	19 0				

Wages Control Account

Dr.				Cr.			
		£	s. d.			£	s. d.
19...				19...			
Feb. 7	To Gen. Led. Adj. A/c. (Wages paid)	780	0 0	Feb. 28	By Work in Progress A/c.	2437	4 0
" 14	Do.	796	10 0	"	" Factory Overhead A/c. (Indirect Wages)	725	2 0
" 21	Do.	786	18 0			<u>£3162</u>	<u>6 0</u>
" 28	Do.	798	18 0			<u>£3162</u>	<u>6 0</u>
		<u>£3162</u>	<u>0 0</u>				

Overhead Expense Control Account

Dr.				Cr.			
		£	s. d.			£	s. d.
19...				19...			
Feb. 28	To Gen. Led. Adj. A/c. (Total Expenses)	1308	0 0	Feb. 28	By Factory Overhead A/c.	685	10
				"	" Administration Overhead A/c.	337	
				"	" Selling Overhead A/c.	285	
		<u>£1308</u>	<u>0 0</u>			<u>£1308</u>	

Factory Overhead Control Account

Dr.

Cr.

19...		£	s.	d.	19...		£	s.	d.
Feb. 28	To Overhead Control A/c.	685	10	0	Feb. 28	Work in Progress : By Sundries (Allocations as per Abstract)	1410	18	0
"	" Wages Control A/c. (Indirect Wages)	725	2	0	"	Adjustment A/c. Difference (under-recovered)	6	15	0
"	" Stores Adjustments	7	1	0					
		<u>£1417</u>	<u>13</u>	<u>0</u>			<u>£1417</u>	<u>13</u>	<u>0</u>

Administration Overhead Control Account

Dr.

Cr.

19...		£	s.	d.	19...		£	s.	d.
Feb. 28	To Overhead Control A/c.	337	2	6	Feb. 28	Work in Progress : By Sundries (as per Abstract)	333	7	6
					"	Adjustment A/c. Difference (under-recovered)	3	15	0
		<u>£337</u>	<u>2</u>	<u>6</u>			<u>£337</u>	<u>2</u>	<u>6</u>

WORK IN PROGRESS ACCOUNT

Dr.

Cr.

19...		£	s.	d.	19...		£	s.	d.
Feb. 1	To Balance : b/d.				Feb. 28	By Finished Stock Control A/c.	J60	6808	8 6
	Material . 675				"	" Balance, Work in Progress : £ s. d.			
	Labour . 615					Material . 697 1 0			
	Overhead 210	1500	0	0		Labour . 630 0 0			
Feb. 28	" Materials A/c.	2670	0	0		Overhead 216 0 0	c/d.	1543	1 0
"	" Wages A/c.	2437	4	0				<u>£8351</u>	<u>9 6</u>
"	" Factory Overhead	1410	18	0					
"	" Admin. Overhead	333	7	6					
		<u>£8351</u>	<u>9</u>	<u>6</u>					

FINISHED STOCK CONTROL ACCOUNT

Dr.

Cr.

19...		£	s.	d.	19...		£	s.	d.
Feb. 1	To Balance b/d.	2550	0	0	Feb. 28	By Cost of Sales A/c.	J62	6652	8 6
" 28	" Work in Progress A/c.	J60	6808	8 6	"	" Balance, Stock on hand	c/d.	2706	0 0
		<u>£9358</u>	<u>8</u>	<u>6</u>				<u>£9358</u>	<u>8 6</u>
19...									
Mar. 1	To Balance b/d.	2706	0	0					

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COST OF SALES ACCOUNT

Dr.				Cr.							
10...			£	s.	d.	10...	£	s.	d.		
Feb. 28	To Finished Stock A/c.	J62	0052	8	6	Feb. 28	By Profit and Loss A/c.	J63	0937	16	0
"	" Selling and Distribution Overhead	J63	285	7	6						
			£0037	10	0				£0937	16	0

OVERHEAD EXPENSES ADJUSTMENT ACCOUNT

OVERHEAD EXPENDITURE												
Dr.						Cr.						
10...				£	s.	d.	10...			£	s.	d.
Feb. 28	To Factory Overhead Control A/c.	6	15	0			Feb. 28	By Profit and Loss A/c.	J64	10	10	0
"	" Admin. Overhead Control A/c.	3	15	0								
				J64	10	10				£10	10	0
					£10	10						

PROFIT AND LOSS ACCOUNT

PROFIT AND LOSS ACCOUNT											
Dr.					Cr.						
19...			£	s.	d.	19...		£	s.	d.	
Feb. 28	To Cost of Sales A/c.	J63	0,937	10	0	Feb. 28	By Sales less all discounts and rebates, etc., as per Gen. Led. Adjust. A/c.	J63	10,422	0	0
"	" Overhead Adjust. A/c.	J64	10	10	0						
"	" Net Profit to Gen. Led. Adjust. A/c.	J64	3,474	3	0						
			<u>£10,422</u>	<u>0</u>	<u>0</u>						

GENERAL LEDGER ADJUSTMENT ACCOUNT

Dr.						Cr.	
10... Feb. 28	To Sales, less all discounts, rebates, etc. as per P. & L. A/c.	£	s. d.	10... Feb. 1 Feb. 28	By Balance	b/d.	£
	Stocks on hand :	10,422	0 0	"	" Stores Materials Control A/c.		0,750
"	Stores	2,482	10 0	"	" Wages Control A/c.		2,400
"	Stock	2,700	0 0	"	" Overhead Control A/c.		3,102
"	Work in Progress	1,513	1 0	"	" P. & L. A/c. balance		1,308
		£17,154	0 0				3,474
							£17,154
				10... Mar. 1	By Balance :	b/d.	2,482
					Stores		2,700
					Stock	"	1,513
					Work in Progress	"	

Third Method of Control.—A Manufacturing Account (sometimes referred to as a Work in Progress Account, or a Cost Ledger Account) is opened in the Financial Books. An account of this nature may be opened for each department of the factory or for each type of goods manufactured.

A corresponding account, entered up on the reverse sides of the account in the Financial Books, may be kept in the Cost Ledger.

The following accounts in the Financial Books form the controls for the Cost Ledger. They are self-explanatory.

FIG. 88.

MANUFACTURING ACCOUNT
(or Cost Ledger Account)

for the 4 weeks ending February 28th, 19.....

Dr.				Cr.			
19...		£	s. d.	19...		£	s. d.
Feb. 1	To Balance, Stocks and Work in Progress b/d.	6,750	0 0	Feb. 28	By Finished Stock or Contracts	6,052	8 6
Feb. 28	„ Purchases (Stores)	2,360	0 0	„	„ Work on Capital Additions to plant	600	0 0
„	„ Purchases (special for contracts)	100	0 0	„	„ Stocks on hand *	5,189	19 0
„	„ Wages (total)	3,162	6 0	„	„ Work in Progress *	1,542	1 0
„	„ Overhead Expenses (excluding Selling and Distribution)	1,022	12 6	„	„ Factory Overhead not recovered to P. & L. A/c.	10	10 0
		<u>£13,394</u>	<u>18 6</u>			<u>£13,394</u>	<u>18 6</u>

* Carried down to next account.

FINISHED STOCK ACCOUNT

Dr.				Cr.			
19...		£	s. d.	19...		£	s. d.
Feb. 1	To Balance b/d.	2,550	0 0	Feb. 28	By Trading A/c. (Cost of Sales)	5,896	8 6
„ 28	„ Manufacturing A/c. (Cost of Goods made)	6,052	8 6	„	„ Stock on hand c/d.	2,706	0 0
		<u>£8,602</u>	<u>8 6</u>			<u>£8,602</u>	<u>8 6</u>

TRADING ACCOUNT

for the month ending February 28th, 19.....

Dr.				Cr.			
19...		£	s. d.	19...		£	s. d.
Feb. 28	To Cost of Sales	5,896	8 6	Feb. 28	By Sales (less returns and allowances)	10,422	9 0
„	„ Factory Overhead Adjustment	10	10 0				
„	„ Gross Profit c/d.	4,515	10 6				
		<u>£10,422</u>	<u>9 0</u>			<u>£10,422</u>	<u>9 0</u>
„	To Selling and Distribution Overhead	285	7 6				
„	„ Net Profit	4,230	8 0		By Gross Profit b/d.	4,515	10 6
		<u>£4,515</u>	<u>10 6</u>			<u>£4,515</u>	<u>10 6</u>

Note.—Compare Contract Control Accounts on pp. 193-4.

Note on Reconciliation of Profit shown by Cost and Financial Books.—The net profit shown by the Financial Books usually differs from that shown by the Cost Ledger, and, generally, that of the Cost Accounts is less than the amount appearing in the financial Profit and Loss Account.

This may arise from several causes, and mention may be made, particularly, of depreciation and interest on Capital. Not infrequently, a higher rate of depreciation is used in the Cost Accounts, particularly if the Financial Accounts include only the rate allowed by the income tax authorities. Again, interest on capital does not appear in the financial accounts, but is occasionally included in the Cost Accounts.

In addition to these items, the Overhead expense in the Financial Accounts is the actual expense incurred or chargeable for the period. In the Cost Accounts, the Overhead is applied by pre-determined rates as a rule, and, consequently, there is an under- or over-allocation of Overhead expense as shown by the sectional Control Accounts to be adjusted to bring the two results into line.

A Reconciliation Account should be prepared to bring the result shown by the two accounting systems into agreement and to prove the accuracy of the accounting, thus :

FIG. 50.

PROFIT AND LOSS RECONCILIATION ACCOUNT
(Cost Ledger)

Dr.				Cr.			
19...		£	s. d.	19...		£	s. d.
Feb. 25	To Overhead under-recovered (Shop B)	7	5 0	Feb. 25	By Net Profit as per Cost Ledger	2500	0 0
"	" Net Profit as per Financial A/cs.	2740	5 0	"	" Depreciation charged in excess of that in Financial A/cs.	150	0 0
				"	" Interest on Capital Assets not charged in Financial A/cs.	84	0 0
				"	" Overhead recovered in excess of actual (Shop A)	13	10 0
		<u>22747</u>	<u>10 0</u>			<u>22747</u>	<u>10 0</u>

Tabular Control Account.—An account of this kind is particularly suitable for factories working on the job order system where tabular Cost Ledger Accounts, or sheets, are kept for the various orders executed.

The total expenditure under each heading of cost is posted monthly from the Abstracts of Materials issued, Direct Expenses, Wages, and Overhead. The items "Charged to Accounts" (Fig.

90) are from the Job Cost Summary, *i.e.* the summary of Costs of completed jobs.

The chief check provided is to prove that the totals, as per the schedules, agree with the total costs of orders, in case any items should have been misposted. An account of this type may be used for an individual large contract which extends over a long period.

FIG. 90.

TABULAR COST CONTROL ACCOUNT
(in the Cost Control Ledger)

Mnth.	Ref.	Abstracts : Totals.					Charged to Accounts : Totals of Completed Jobs.		
		Direct Pur- chases.	Stores.	Wages.	Over- head.	Total.	No.	Name.	
19...		£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.			£ s. d.
Jan.	b/d.	15 0 0	86 0 0	53 0 0	59 0 0	81 0 0 213 0 0	92 83	J. Hows B. Pitts Expense A/cs. In Progress	132 0 0 41 0 0 23 0 0 98 0 0
						£294 0 0			£294 0 0
Feb.	b/d.					98 0 0			

EXAMINATION QUESTIONS

1. The following represents the Trading and Profit and Loss Account (abridged) of a manufacturer of a patent fire extinguisher of a standard type.

TRADING AND PROFIT AND LOSS ACCOUNT FOR THE YEAR ENDED
DEC. 31, 19..

	£	s.	d.		£	s.	d.
To Materials Used	2915	0	0	By Sales	7500	0	0
.. Productive Wages	1861	0	0	.. Stock of Finished			
.. Factory Expenses	1405	10	0	Articles	181	5	0
.. Gross Profit (car- ried down)	2052	15	0	.. Work in Progress :			
				£			
				Materials	280		
				Wages	156		
				Factory			
				Expenses	117		
					553	0	0
	£8234	5	0		£8234	5	0
To Administration				By Gross Profit			
Expenses	1365	0	0	(brought down)	2052	15	0
.. Net Profit	687	15	0				
	£2052	15	0		£2052	15	0

1550 Extinguishers were manufactured during the year and 1500 were sold during the same period.

The cost records which had been kept showed that Factory Expenses worked out at 16s. 6d. and Administration Expenses at 18s. 1½d. per article produced, the Cost Accounts showing an estimated total profit of £703 2s. 6d. for the year.

From the foregoing information, you are required to prepare :

- (a) Factory Expenses Oncost Account.
- (b) Administration Expenses Oncost Account.
- (c) An Account showing the reconciliation between the total figure of net profit as per the cost accounts and the figure of net profit shown in the financial books.

Institute of Cost and Works Accountants (Final).

2. Prepare in the Cost Ledger an expense account for the General Offices of a manufacturing business showing all the items which comprise the cost and indicate on the credit side how you would distribute the total cost.—*Institute of Cost and Works Accountants (Inter.).*

3. Explain the working of Stores Control Accounts. If at the time of stocktaking the quantity of counted stock should be found to differ considerably from the total shown in the Control Account, what conclusion would you draw, and why?—*London Chamber of Commerce.*

4. What value do you attach to the reconciliation of Cost Accounts and Financial Accounts? If you find at the end of an accounting period that there are serious differences, where would you expect to find these, and how would you deal with them in your Cost Accounts?—*Institute of Cost and Works Accountants (Final).*

5. Describe briefly a Work in Progress Account and illustrate its relation to the Financial Accounts.—*Royal Society of Arts (Advanced).*

6. State shortly the means by which you would reconcile the Cost Accounts with the financial books of the business.—*Society of Incorporated Accountants and Auditors (Inter.).*

7. Prepare a manufacturing account, incorporating the following figures :

	£
Production Account (Factory output)	17,700
Work in progress, January 1	2,400
Work in progress, December 31	3,000
Materials, viz. :	£
Stores (January 1)	1,500
Purchases	5,400
	<hr/> 6,900
Less Stores (December 31)	1,740
	<hr/> 5,160
Labour	9,000
Rent, Rates and Taxes	1,000
Electric Power	500
Electric Light	140
Heating	200
Superintendence and Clerical Assistance	1,100
Small Tools	400
Maintenance and Depreciation	500
Interest	300

Society of Incorporated Accountants and Auditors (Final).

8. Under what general heads should the items appearing in a Trading and Profit and Loss Account be grouped for the purpose of comparing the financial and cost accounts of a business and to what element of cost will the expenditure under each head correspond?

In spite of the close relationship between cost and financial accounts there are instances of important differences between the two sets of accounts. Indicate the nature of such differences.—*Society of Incorporated Accountants and Auditors (Inter.)*.

9. What are the principal difficulties encountered in reconciliation of cost and financial accounts? How are they overcome?—*Institute of Cost and Works Accountants (Final)*.

10. It is the practice in a certain factory to charge overheads to the products by means of pre-determined hourly rates. How would you propose to deal with the following under- or over-absorbed overhead at the end of an accounting period :

	Overhead incurred.	Overhead absorbed.	Balance.
Department A . .	£2,000	£2,200	+£200
Department B . .	£1,500	£1,300	—£200
Department C . .	£1,100	£1,000	—£100

Institute of Cost and Works Accountants (Inter.).

11. Describe the method you would suggest for ensuring the agreement of works accounts with the financial accounts, showing the principal corresponding headings in each.—*Institute of Cost and Works Accountants (Final)*.

12. Describe the means you would adopt in order to ascertain whether the total overheads as allocated to the Cost Accounts agree with the financial accounts at the end of a given period, and explain how you would deal with any differences.—*Institute of Cost and Works Accountants (Final)*.

13. What provision should be made to ensure exact correspondence between the cost records and the financial accounts of a business?—*Institute of Cost and Works Accountants (Final)*.

14. Indicate the Cost Control accounts necessary for a manufacturing business and define their functions.—*Institute of Cost and Works Accountants (Inter.)*.

15. Where it is proved that the account of overheads applied to cost fall considerably short of the expense recovered in the financial accounts, what method would you adopt to ascertain and rectify the discrepancy?—*Institute of Cost and Works Accountants (Final)*.

16. Describe briefly how you would deal with under-recovered and over-recovered administrative and selling expenses. Should the following year's cost accounts be affected by either circumstance?—*Institute of Cost and Works Accountants (Final)*.

17. Describe how you would secure the interlocking of the cost accounts and the financial accounts for any business with which you are familiar.—*Institute of Cost and Works Accountants (Final)*.

18. Describe with illustration a Work in Progress Account and state its uses. Mention the origin of the information contained in it, and explain its relation to the financial accounts.—*Institute of Cost and Works Accountants (Final)*.

19. Explain the necessity for reconciling cost and financial accounts. State what disagreements you would expect to find and how you would deal with them.—*Institute of Cost and Works Accountants (Final)*.

20. The products of a manufacturing concern are wide and various. At the end of the financial year the value of Stock and Work in Progress is urgently required. Describe a system that would give accurate and speedy returns.—*Institute of Cost and Works Accountants (Final)*.

21. In connection with any system of Costing it is important to see that the Financial Accounts are kept in such a way as to afford a ready means of agreement of the total wages, materials, expenses, and charges

In spite of the close relationship between cost and financial accounts there are instances of important differences between the two sets of accounts. Indicate the nature of such differences.—*Society of Incorporated Accountants and Auditors (Inter.)*.

9. What are the principal difficulties encountered in reconciliation of cost and financial accounts? How are they overcome?—*Institute of Cost and Works Accountants (Final)*.

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	Overhead incurred.	Overhead absorbed.	Balance.
Department A . .	£2,000	£2,200	+£200
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Department C . .	£1,100	£1,000	—£100

Institute of Cost and Works Accountants (Inter.).

11. Describe the method you would suggest for ensuring the agreement of works accounts with the financial accounts, showing the principal corresponding headings in each.—*Institute of Cost and Works Accountants (Final)*.

12. Describe the means you would adopt in order to ascertain whether the total overheads as allocated to the Cost Accounts agree with the financial accounts at the end of a given period, and explain how you would deal with any differences.—*Institute of Cost and Works Accountants (Final)*.

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14. Indicate the Cost Control accounts necessary for a manufacturing business and define their functions.—*Institute of Cost and Works Accountants (Inter.)*.

15. Where it is proved that the account of overheads applied to cost fall considerably short of the expense recovered in the financial accounts, what method would you adopt to ascertain and rectify the discrepancy?—*Institute of Cost and Works Accountants (Final)*.

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18. Describe with illustration a Work in Progress Account and state its uses. Mention the origin of the information contained in it, and explain its relation to the financial accounts.—*Institute of Cost and Works Accountants (Final)*.

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20. The products of a manufacturing concern are wide and various. At the end of the financial year the value of Stock and Work in Progress is urgently required. Describe a system that would give accurate and speedy returns.—*Institute of Cost and Works Accountants (Final)*.

21. In connection with any system of Costing it is important to see that the Financial Accounts are kept in such a way as to afford a ready means of agreement of the total wages, materials, expenses, and charges

- (a) Completed Jobs Account.
- (b) Work in Progress Account.
- (c) Finished Stock Account.
- (d) Works Oncost Account.
- (e) Works Oncost Suspense Account.
- (f) Office Oncost Account.
- (g) Office Oncost Suspense Account.
- (h) Manufacturing Account.

The Profit or Loss on Completed Contracts and Sales from Stock should also be shown.

Productive Wages on Completed Jobs	£400
Productive Wages on Work in Progress	100
Stores used on Completed Jobs	700
Stores used on Work in Progress	300
Direct Materials on Completed Jobs	100
Direct Materials on Work in Progress	20
Chargeable Expenses on Completed Jobs	20
Chargeable Expenses on Work in Progress	10
Transfers from Finished Stock to Completed Jobs	75
Works Oncost to be charged at 75 per cent. on Productive Wages.	
Office Oncost to be charged at 10 per cent. on Works Cost.	
Contract Price of Completed Contracts	£1,700
Sales from Finished Stock	350
Finished Stock on hand as at 30th June, 1931	250
Transfers from Completed Jobs to Finished Stock	475

The Ledger Accounts should be ruled off as at 30th June 1931, and balances, if any, brought down as at 1st July, 1931. No Journal Entries are required.—*Association of Certified and Corporate Accountants (Final)*.

27. Detail the steps you would take to reconcile the Cost Accounts with the Financial Accounts, and state where you would expect to find discrepancies. Indicate the probable cause of the discrepancies and how you would deal with same in the cost books.—*Association of Certified and Corporate Accountants (Final)*.

28. The following balances are shown in the Cost Ledger as at 1st January, 1933 :—

	Dr.	Cr.
Work in Progress Account	£1,960	
Finished Stock Account	1,465	
Works Oncost Suspense Account	100	
Office and Administration Oncost Suspense Account	50	
Stores Ledger Control Account	2,625	
Cost Ledger Control Account		£6,200

Transactions for the year ended 31st December, 1933, were :

Wages Paid	£16,000
Allocated :—Direct Labour	£15,300
Indirect Labour	700
Works Oncost allocated to Production	4,675
Office and Administration Oncost allocated to Production	1,550
Stores issued to Production	9,825
Goods finished during year	30,000
Finished goods sold	33,000
Stores Purchased	9,000
Stores issued to Factory Repair Orders	375
Carriage Inwards on Stores used for Production	150
Works Expenses	3,500
Office and Administration Expenses	1,500

CHAPTER XVI

PROCESS COSTING

Process Costing.—This is a method of Costing used to ascertain the cost of the product at each process, operation, or stage of manufacture, where processes are carried on having one or more of the following features :

(1) Where the product of one process becomes the material of another process or operation.

(2) Where there is simultaneous production, at one or more processes, of different products, with or without by-products.

(3) Where, during one or more processes or operations of a series, the products, or materials, are not distinguishable from one another, as, for instance, when the finished products differ finally only in shape or form.

The system provides for showing the Cost of the main products and of any by-products. The method is very different from Job Order Costing, where each job is separately costed. Orders may be combined for common process production to a certain stage, and then be costed for subsequent operations by Job Cost methods.

In most cases, Process Costing requires fewer forms, and less details, than are needed for Job Costs, but a closer analysis of operations. For example, there is not the need for the abstracting of labour to so many order numbers, and material is issued in bulk to departments, rather than to many specific jobs. In continuous processes, as in a coal distillation plant, the men are occupied continuously on each process.

The Application of the Method.—The industries in which Process Costs may be used are very many, in fact, except where Job, or Batch Costing, and Unit Operation Costing is necessary, a Process Costing system can usually be devised.

In particular, the following may be mentioned as a few examples :

Chemical works.
Soap-making.
Box-making.

Textiles, weaving,
spinning, etc.
Food products.

Distillation processes.
Coking works.
Paper-mills.
Biscuit works.

Canning factories.
Paint, ink, and varnish-
making, etc.

The General Features of Process Cost Systems.—An account is kept for each process or operation. Materials, labour, and expenses are debited, by-products and waste are credited, whilst the material, as modified at the first operation, is passed on to the next process. If by-products require further treatment, the same procedure is followed.

Put in another way, the “finished product” of the first process becomes the “raw material” of the next one, and so on, until the final products are completed. Each Process Account, in fact, represents a subdivision of a Manufacturing Account, so that the works cost of each process is separately ascertained, and from which the unit cost at each operation may be calculated.

Single or Output Costing resembles Process Costing in which there is but one process where every unit is identical. Sometimes Unit Costing is combined with Process Costing, the method being to cost by the unit of production, where manufacture is continuous, and the units are identical, or can be made equivalent by means of ratios.

Departmental Costing differs in that separate products are, generally, dealt with in each department, whereas, in Process Costing, the same material passes from one operation or process to another in altered form. When two or more distinct varieties of goods are manufactured, separate departmental costs are desirable, so that the profit made by each department may be revealed.

Types of Process Work to be Considered.—The nature of the industry will determine the arrangement of the Process Accounts. Examples will be used to illustrate the types of manufacture which are frequently met with :

1. Where the raw material passes through a sequential series of processes before completion, there being no by-products, and no need for Stock Accounts at intermediate stages, *e.g.* glass-bottle works, earthenware, paper-making, etc.

2. Where there are no by-products, but it is necessary to use a Stock Account for each process, or for some of the processes, *e.g.* engineering factories using mass production and repetition methods; cotton and wool textiles.

3. Where by-products arise, and have to be costed, e.g. gas manufacture, coke-oven works, chemical works, distillation processes, refineries.

Standard Costs in Process Costing.—In industries where Process Costing is suitable, Standard Costs may be used with great advantage. Standard Costs provide a measure against which actual costs may be compared. Standard Costing, in connection with Process Accounts, gives the management an excellent measure of the efficiency of production, and it may be mentioned that accounting systems on these lines are being more widely used every year. This modern method is dealt with fully in another chapter.

The Use of Numerical Nomenclature.—In an earlier chapter the use of works order numbers and standing order numbers was described with examples. The identification of cost to processes by means of Process Order Numbers facilitates the collection of the necessary details, ensures a proper allocation of expenditure to each process, and simplifies expense analysis.

The adoption of departmental or process numbers is necessary when mechanical sorting and tabulatory machines are used, and these mechanical methods are being more widely adopted every year. In large factories these machines are indispensable, if prompt cost and production figures are required. Special chapters (Chs. XXVI–XXVIII) are devoted to costing by these remarkable machines.

A Theoretical Example of Process Costing.—In order that the practical illustrations of Process Costing may be more easily understood, the simple theoretical example below is given.

MAKING CHINA BOWLS

Process I. Grinding materials (white clay, felspar, and flints).

Process II. Pressing and casting in moulds and turning on lathe to remove excess material and inequalities of the exterior surface.

Process III. Articles placed in Saggars and baked.

Process IV. Glazing or decorating, and firing in glost oven.

N.B.—The grouping of processes as shown is merely arbitrary for illustration.

In the above *pro forma* accounts, which represent Process Accounts in their simplest form, it is assumed that the whole of the raw material is passed into manufacture, through each

FIG. 91.

THE COST LEDGER ACCOUNTS

Dr.		1. Grinding Account										Cr.		
19...		Fo.	£	s.	d.	19...		Fo.	Cwt.	Q.	lb.	£	s.	d.
	To Materials :						By Moulding							
	White clay .		20	0	0		A/c.	2	33	0	0	98	2	0
	Felspar .		15	9	6									
	Flints .		5	7	6									
	„ Wages .		21	0	0									
	„ Departmental													
	expense as													
	per allocation													
	„		36	5	0									
			<u>£98</u>	<u>2</u>	<u>0</u>				<u>38</u>	<u>0</u>	<u>0</u>	<u>£98</u>	<u>2</u>	<u>0</u>

Dr.		2. Moulding and Turning Account										Cr.	
19...		Fo.	£	s.	d.	19...		Fo.	Qty.	£	s.	d.	
	To Materials from						By Process III						
	Process I .	1	98	2	0		(Baking) .	3	3668	183	8	0	
	„ Wages . .		60	0	0								
	„ Works ex-						(Unit cost 1s.)						
	penses .		25	6	0								
			<u>£183</u>	<u>8</u>	<u>0</u>				<u>3668</u>	<u>£183</u>	<u>8</u>	<u>0</u>	

Dr.		3. Baking Account						Cr.				
19...		Fo.	£	s.	d.	19...		Fo.	Qty.	£	s.	d.
	To Materials from						By Process IV					
	Process II .	2	183	8	0		(Glazing) .	4	3500	218	17	8
	„ Wages .		15	0	8		„ Scrapped .		168	-	-	-
	„ Works ex-											
	penses .		20	9	0							
			<u>£218</u>	<u>17</u>	<u>8</u>		(Unit cost					
							1s. 3d.)		<u>3668</u>	<u>£218</u>	<u>17</u>	<u>8</u>

Dr.		4. Glazing Process										Cr.	
19...		Fo.	£	s.	d.	19...		Fo.	Qty.	£	s.	d.	
	To Materials from Process III.	3	218	17	8		By Finished Stock A/c .	5	3400	280	10	0	
	„ Stores Mater- ials . . .		12	1	4		„ Scrapped and rejected .		100	-	-	-	
	„ Wages . .		34	7	6								
	„ Works ex- penses . .		15	3	6								
			£280	10	0		(Unit cost 1s. 7.8d.)		3500	£280	10	0	

process in succession. At each process the unit cost is shown, and the unit cost of each process is represented by the difference between the cost per unit of one process and the preceding one. The "finished" product of Process I is the "raw material" of Process II, and so on, each transferred at cost.*

* Sometimes these transfers are made to show the transferring process a profit. The reason, and stock valuation problems arising, are dealt with on page 245.

EXAMPLE OF PROCESS ACCOUNTS WITH INTERMEDIATE STOCK ACCOUNTS

Process Stock Accounts.—In the preceding example no intermediate stocks of part-finished articles are held. It is necessary in some forms of manufacturing to accumulate stocks of articles at one or more of the operations, *e.g.* when it is desired to complete subsequent operations or processes only when and in such quantities as may be required for specific orders.

This may occur, for instance, when standard articles are made by repetition work up to a certain stage, and completed to particular specifications of customers. In such cases there are usually well-defined stages of production.

When this procedure is adopted, it is convenient to introduce separate process Stock Accounts, which are debited at cost with the quantities made at each process. The quantities drawn from the Part-finished Goods Store are credited to this Stock Account, and debited at cost to the account of the next process. The procedure is illustrated in the following accounts :

Process I. Brass castings are made to a standard model suitable for machining to two styles.

Process II. Castings machined to the stock patterns.

Process III. The machined articles are polished and lacquered, or enamelled as may be required.

FIG. 92.

PROCESS I									
Dr.					Cr.				
Casting Account									
19...		Fo.	£	s. d.	19...		Fo.	Unit cost.	No. made.
								s. d.	
To Metal . . .	6	60	9	0	By Castings Stock A/c. . .	2	2	0	1082
" Wages . . .	8	20	7	0					
" Patterns . . .	9	6	8	0					
" Foundry expenses . .	J10	21	0	0					
			£108	4 0					1082
									£108 4 0
PROCESS II									
Dr.					Cr.				
Casting Stock Account									
19...		Fo.	£	s. d.	19...		Fo.	Unit cost.	No. made.
								s. d.	
To Balance . . .	b/d.	802	85	1 0	Jan. 7 By Process I A/c. . .	3	2	1	900
" Castings A/c. (Process I) . .	1	1082	108	4 0	" " Stock . .	c/d.	2	1	984
			£1884	£196 5 0					1884
									£196 5 0
Jan. 7 To balance . .	b/d.	984	102	10 0					

PROCESS II

Machining Account

Dr.

Cr.

19...		Fo.	No.	£	s.	d.	19...		Fo.	Unit cost.	No.	£	s.	d.	
Jan. 7	To Castings Stock A/c.	2	900	93	15	0	Jan. 14	By Process III A/c.	4	3	2	790	123	1	8
Jan. 14	" Labour	12	-	24	0	0	"	" Scrapped castings	-	-	-	10	-	-	-
"	" Expenses as allocation	J13	-	21	0	0	"	" Work in Progress	c/d.	-	-	100	13	13	4
			900	£138	15	0						900	£138	15	0
Mar. 1	To Work in Progress	b/d.	100	13	13	4									

PROCESS III

Finishing Account

Dr.

Cr.

19...		Fo.	No.	£	s.	d.	19...		Fo.	Unit cost.	No.	£	s.	d.	
Jan. 14	To Machining A/c.	3	790	123	1	8	Jan. 21	By Pieces rejected	-	-	15	-	-	-	
Jan. 21	„ Stores materials	15	-	8	0	0	„	„ Finished Stock A/c.	J17	3	9.5	775	147	6	10
„	„ Wages	16	-	14	5	2									
			<u>790</u>	<u>£147</u>	<u>6</u>	<u>10</u>						<u>790</u>	<u>£147</u>	<u>6</u>	<u>10</u>

Internal Process Profits.—Sometimes the output from one process is transferred to a subsequent process, not at cost as shown in the preceding examples, but at a price showing a profit to the transferer process. For instance, at a price corresponding to current wholesale market prices or at cost plus an agreed percentage. The object is (a) to show whether the cost of production competes with market prices, (b) to make each process stand on its own efficiency and economies, *i.e.* the transferee processes are not given the benefit, when comparing the cost at that stage with external prices, of economies effected in the earlier process.

It is an unnecessary complication in the accounts, as the desired comparisons could be prepared on separate cost reports for each process. The complexity brought into the accounts arises from the fact that these inter-process profits so introduced remain included in price of process stocks, finished stocks, and work-in-progress, and, for Balance Sheet purposes, must be eliminated by the creation of proper reserves. Until actually sold, the profit on such stock, being unrealised, cannot be taken credit for, hence each process profit must be reduced by the profit in the value of the unsold stock.

The procedure may be illustrated from the following example :

PROCESS I.

To Cost of Material, Labour, and Expenses	£ 225	By Transfer to Process II (Cost plus 33½% on Cost)	£ 300
„ Process Profit transferred	75		
	<u>£300</u>		<u>£300</u>

PROCESS II.

To Process I Material	£ 300	By Completed Stock on hand at Cost	£ 150
„ Other Material, Wages, and Expenses	750	„ Transfer to Process III (Cost plus 33½% on Cost)	1200
„ Process Profit transferred	300		
	<u>£1350</u>		<u>£1350</u>

In Process II the cost of the output transferred is £1050 less £150, i.e. £900. Of the £1050 there is £300 from Process I, which includes 25% internal profit (N.B. 33½% on cost equals 25% on transfer price), hence the completed stock on hand, £150, contains some of that profit which should be reserved for, thus :

$$25\% \text{ of } \frac{300}{1050} \times 150 = £10.7; \text{ or } \frac{150}{1050} \times 75 = £10.7 \text{ Reserve.}$$

This is a reserve against the £300 profit shown for Process II.

At later processes similar calculations will have to be made in respect of any stock on hand at each process. Should the whole output be sold, then no reserve is required. The calculations become involved after the second process, because it is necessary to eliminate not only the proportion of profit in the preceding process, but also of that in *each* preceding process. This involves a chain of reserves being calculated, hence the objection to this method of pricing process materials transferred.

EXAMPLE OF ACCOUNTS OF PROCESSES WITH BY-PRODUCTS

Process Costs of By-products.—For the purpose of illustration assume that crude oil is distilled, producing (a) light oil, (b) medium oil, (c) heavy residue, which is used as fuel. The light and medium oils undergo further fractional distillation.

The processes may be summarised as follows :

1. Crude oil distilled, producing

(a) Light oil ; (b) Medium oil ; (c) A residue which is used as fuel for the furnaces.

2. Light oil after passing through a treatment involving the use of sulphuric acid and caustic soda is fractionally distilled producing :

(a) Benzole ; (b) Toluene ; (c) Solvent naphtha, part of which is used in process No. III and some is sold.

3. Medium oil passes through a process requiring the use of sulphuric acid, caustic soda, and solvent naphtha, and produces:

(a) Carboic acid ; (b) Chemical N ; (c) Residue M, which is stored in drums for sale.

In the following accounts a column for Unit Cost as in Fig. 92 would usually be introduced, but is omitted here for simplicity.

FIG. 93.

THE PROCESS ACCOUNTS

1. Crude Oil Distillation

Dr.					Cr.				
19...		Fo.	Qty. T. C.	£ s. d.	19...		Fo.	Qty. Gals.	£ s. d.
Feb. 28	To Materials (crude oil) .		2 0	200 9 6	Feb. 28	By Light oil .		4000	160 0 0
"	" Fuel .		-	22 10 0	"	" Medium oil .		3000	120 0 0
"	" Wages .		-	42 11 6	"	" Residue to Fuel A/c. .		520	13 0 0
"	" Expenses .		-	27 9 0					
				<u>£293 0 0</u>					<u>£293 0 0</u>

Note.—After deducting an agreed or market value for fuel residue, this being debited to Fuel Account, the balance of the cost of the process is either allocated on the works chemist's formula based on average proportional quantities of each produced per ton of crude material as described in Ch. XVII, or, in some cases, the quantities of resulting products can be definitely measured in common units, and the cost be apportioned in proportion thereto.

2. Light Oil Distillation Account

Dr.					Cr.				
19...		Fo.	Qty. Gals.	£ s. d.	19...		Fo.	Qty. Gals.	£ s. d.
Feb. 28	To Process I .	1	4000	160 0 0	Feb. 28	By Benzole A/c. .		3800	245 10 0
"	" Sulphuric Acid .	7	-	20 9 0	"	" Toluene A/c. .		50	15 2 6
"	" Caustic Soda .	8	-	15 0 6	"	" Solvent Naphtha A/c. .	S.2	100	12 0 6
"	" Wages .	72	-	24 1 6	"	" Loss in Process .		50	- - -
"	" Expenses .	18	-	53 2 0					
			<u>4000</u>	<u>£272 13 0</u>				<u>4000</u>	<u>£272 13 0</u>

S.2 Solvent Naphtha Account

Dr.					Cr.				
19...		Fo.	Qty. Gals.	£ s. d.	19...		Fo.	Qty. Gals.	£ s. d.
Feb. 1	To Balance (Stock) .	b/d.	209	24 0 0	Feb. 28	By Process III (at Cost) .	3	90	11 12 6
" 28	" Process II .	2	100	12 0 6	"	" Cost of Sales to Trading A/c. .	5	108	13 19 0
"	" Storage expense .	18	-	3 10 0	"	" Balance (Stock) .	c/d.	111	13 19 0
			<u>309</u>	<u>£39 10 6</u>				<u>309</u>	<u>£39 10 6</u>
Mar. 1	To Balance (Stock) .	b/d.	111	18 19 0					

Note.—Similar accounts for benzole and toluene.

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Dr.		3. Medium Oil Distillation Account										Cr.	
19...		Fo.	Qty. Gals.	£	s.	d.	19...		Fo.	Qty. Gals.	£	s.	d.
Feb. 28	To Process I.	1	3000	120	0	0	Feb. 28	By Carbolic A/c.	5	2100	159	3	8
"	" Sulphuric Acid	7	-	15	7	0	"	" "N" A/c.	6	520	37	18	0
"	" Canstic Soda	8	-	10	18	0	"	" Residue "M" A/c.	S.4	360	30	6	4
"	" Solvent						"	" Loss in Process	-	20	-	-	-
"	" Naphtha A/c.	S.2	-	11	12	6							
"	" Wages	72	-	23	2	6							
"	" Expenses	18	-	46	8	0							
			3000	£227	8	0				3000	£227	8	0

Dr.		S.4 Residue "M" Account										Cr.	
19...		Fo.	Qty. Gals.	£	s.	d.	19...		Fo.	Qty. Gals.	£	s.	d.
Feb. 1	To Stock.	b/d.	120	10	12	0	Feb. 28	By Cost of Sales to Trading A/c.		319	31	18	0
Feb. 28	" Process III	3	360	30	6	4	"	" Balance	c/d.	161	16	2	0
"	" Packing and storage	18	-	7	1	8				480	£48	0	0
				480	£48	0							

Note.—Similar accounts for carbolic acid and chemical "N."

TRADING AND PROFIT AND LOSS ACCOUNT														
Dr.			for the month ending February 28th, 19.....							Cr.				
19...			Fo.	£	s.	d.	19...			Fo.	% G. Profit	£	s.	d.
Feb. 28	To Manufacturing Cost of Sales:						Feb. 28	By Sales (less returns):						
		Qty.						Benzole	25.0	265	2	8		
	Benzole	3040		198	17	0		Toluene	50.0	16	2	0		
	Toluene	26		8	1	0		Solvent	20.0	17	8	0		
	Solvent							Naphtha	42.9	254	4	0		
	Naphtha	108		13	19	0		Carbolic Chemical	50.0	69	12	8		
	Carbolic Chemical	1900		145	4	0		"N"						
	"N"	410		30	6	4		Residue "M"	23.1	41	10	5		
	Residue "M"	319		31	18	0								
				428	5	4								
"	" Overhead Expenses Adjust-													
	ment A/c.			2	1	7								
"	" Stores Adjust-													
	ment A/c.			6	0	1								
"	" Gross Profit on Manufacturing (33 1/3%)		c/d.	218	13	6								
				£655	0	6						£655	0	6
Feb. 28	To Overhead Expenses:						Feb. 28	By Gross Profit		b/d.	218	13	6	
	Selling			21	17	4								
	Distribution			11	2	2								
"	" Net profit for the month to Balance Sheet			185	14	0								
				£218	13	6						£218	13	6

N.B.—Separate Trading Accounts may be used for each product as shown in Fig. 106, CH. XVII.

Apportioning of Cost to By-products.—In the above accounts the apportionment of expenses to the products in each process is based on a proportion decided by a formula provided by the works chemist. Another method is to resolve the quantity of each product into its equivalent weight, in the terms of the original material, as is explained in Chapter XVII, dealing with Coal Distillation Accounts, and to apportion costs proportionately.

Intermediate Stock Accounts.—The use of separate Stock Accounts for each of the products and by-products facilitates the charging of any quantities which are used in other processes, as in Process I, where a by-product is used as furnace fuel, and in Process III, where solvent naphtha is used as a cleansing material, a quantity not so used being sold. In many cases the processes are so continuous that intermediate stocks do not arise.

Each process is carefully defined, and debited with materials used therein, and with its fair share of the works expenses. The correct charging of overhead expenses to processes is facilitated, and kept uniform, by using a schedule of expense- or standing-order numbers, and process and product cost numbers for the main accounts. When mechanical sorting and tabulating machines are used, this numerical system is necessary. The procedure for using these machines is described in Chapter XXVI.

Loss in Process.—In most processes there arises a loss of weight, or volume, in the course of manufacture, and this is particularly the case where there is water content, or where distillation, or disintegration, by heat or chemical action is necessitated, *e.g.* in foundry work; carbonisation of coal for coke and by-products; and distillation of crude oils. Careful cost control assists the manager to minimise these losses in some instances, but, in many cases, they are inherent and inevitable.

As all the material taken into process is duly debited to the appropriate process, normal loss need not be separately debited; it is, however, entered on the credit side of the Process Account concerned, in the quantity column only. This results in the cost of the loss being thrown into the cost of the products recovered. *Alternatively*, the cost of the good output may be shown on the basis of 100% good production, and to such cost of good output may be added the cost of any scrapped or re-processed work.

This addition may be in detail as to wages, materials, and overhead; or merely as the complete cost of scrap and re-

processed work. The latter is more practical in most forms of process costing when this alternative ascertainment of cost is used.

Abnormal waste is excluded from cost by transferring the value direct to Works Profit and Loss Account.

Process Residuals and Process Scrap.—When residuals, or scrap, are recovered for use or for sale, usually the value is credited to the particular process, but sometimes direct to Trading Account. To make residuals usable it may be necessary to pass them through a recovery, or renovating, process, for which a separate account is required to ascertain the cost. Acids used in some chemical processes are frequently dealt with in this way.

The Application of Process Accounts to coal distillation works is dealt with in Ch. XVII.

EXAMPLE OF TABULAR PRESENTATION OF PROCESS COSTS

Manufacture of Cordite

Factory Organisation.—The system to be described has three distinct manufacturing departments. Each controls definite steps in the making of the product.

Service sections, in addition to the usual office and stores departments, comprise :

- (a) Laboratory and research.
- (b) Chemical plumbers.
- (c) Maintenance of plant.
- (d) Maintenance of buildings.

The Processes.—Cordite is made from a mixture, in certain proportions, of guncotton (nitro-cotton), and nitro-glycerine.

The three separate manufacturing departments are :

- (1) Making guncotton.
- (2) Making nitro-glycerine.
- (3) Combining these ingredients and finishing the cordite as sticks of various lengths, or thickness; or as long thread on reels.

The Procedure for Costing.—In the particular factory in which the procedure described is adopted, each process takes as a direct charge any expenses as they accrue, *e.g.* (a) trucking from one process to another is charged direct to the receiving process; (b) maintenance of plant and buildings, for which purpose definite allocations are made possible. Only those expenses

which cannot be broken down to a process charge directly are included in General Overhead.

The Process Operations.—Process. I.—Dried cotton waste is nitrated in stoneware pans with a mixture of nitric and sulphuric acids of certain strengths. After a time, the acid is displaced by water. The used acid is led back to tanks for revivifying (By-process II). The nitrated cotton is trucked to Process II.

Fig. 94 shows the headings under which costs are collated.

Fig. 95 is an excerpt showing how these costs are set out to show a total cost, and a cost per lb. for each process for the use of the management.

It will be seen that this Cost Summary opens with the average cost for the preceding year. This provides a comparison for each of the thirteen four-weekly periods of the year. The

FIG. 94.

HEADINGS OF ACCOUNTS FOR NITRATION OF COTTON

Process.	Sectional Services.	General Overhead.
<i>Materials :</i> Nitric acid. Sulphuric acid. <i>Direct Labour.</i> <i>Water, Steam, and Power :</i> Steam. Electric power. M.W.B. water. Hydraulic power. Fuel. Refrigeration. Compressed air. Pumping canal water. <i>Foremen and Leading Hands.</i> <i>Indirect Labour :</i> Sweepers and cleaners. Attendance on motors. Oiling, cleaning, and belt-men. <i>Maintenance :</i> Plant. Buildings. <i>Miscellaneous :</i> Depreciation. Consumable stores. Internal transport. Rates. Balance of process expenses.	<i>Water, Steam, and Power :</i> Electric light. Steam for heating. Gas. <i>Maintenance Services.</i> <i>Miscellaneous :</i> Care and custody of Departmental Stores. Credit material returned to Store. Bookkeepers. Sweepers and general labour. Allowance payments. O.T. and N.S. Bonus. Management (Chemists, etc.). Balance of Sectional expenses. <i>Laboratory Testing.</i>	<i>General Expenses :</i> Superintendence. Registry, Pay, and Order Branches. Worktakers, Wages and Accounts. General Stores. Police, Fire Brigade, and Warders. Maintenance of Grounds, Mains, Canals, Permanent Way, etc. Non-effective charges. Balance of general expenses, includes water, plant, buildings, and idle buildings.

average for the present year is inserted after the end of the year, and this is compared with the opening average for the preceding year. The value of this method is that the management can see at every period how the costs are moving. The Work in Progress for each period is recorded as shown in Fig. 96.

FIG. 65.

COST SHEET SHOWING CORDITE COSTS FOR EACH FOUR-WEEKS PERIOD

Production.

OUTPUT.	PERIOD. (4-weekly.)	MATERIALS.*				DIRECT LABOUR.			PROCESS STEAM AND OTHER SERVICES.			GENERAL OVERHEAD.		TOTAL PRO- CESS COST.	
		QTY. lbs.	Rate per lb. d.	Total. £ s. d.	Cost per Unit of lb. d.	Hours.	Total. £ s. d.	Rate per lb. d.	Qty.	Rate per lb. d.	£ s. d.	Rate.	£ s. d.	Cost per lb. £ s. d.	Total. £ s. d.
Average previous year.	1														
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														
	11														
	12														
	13														
Total for Year															

* This section repeated for each of the three process materials.

Fig. 96.

Period, (four weeks.)	Work in Progress, Process I.				Work in Progress, Process II.				
	At Beginning of Period.		At End of Period.		At Beginning of Period.		At End of Period.		
	Quantity.	Rate.	Value.	Quantity.	Rate.	Value.	Quantity.	Rate.	Value.
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									

By adding or deducting the quantities and values transferred from one process to another the actual output is ascertained.

The By-processes for Acid are :

- I. Manufacture of new nitric acid.
- II. Concentration of weak used nitric acid.

For costing purposes, the bulks of the two acids are reduced to one nominal strength, referred to as 100 per cent. acid, i.e. volume and analysis both taken into account.

The cost of these by-processes is built up by debiting material, labour, and expense, and the value so ascertained is used for charging the acid to the Nitration Process above. Sulphuric acid is charged at purchased price for oleum. Sodium nitrate is heated with sulphuric acid, producing nitric acid.

The charge for acid to Process I is found by taking the stock of nitric and sulphuric acid at the beginning of each period, plus new acid made, or bought, less the quantity held at the end of the period. The balance represents acid lost in process, to be charged.

The cordite emerging in Process III has to be stoved. It is in different sizes, requiring varying times to dry. The expense is split up in direct proportion to the lbs. passing through, irrespective of size.

In this process, stocks not fully processed at the end of each four-weekly period have to be valued on a technical report as to the quantity in process, and the extent to which they have been subjected to the process. The stock is then valued proportionately.

Summary Costs.—The above procedure is used for finding the process costs per lb. to enable the management to test the works efficiency.

The summary costs are shown in two ways :

METHOD I

In Fig. 97 the cost is accumulated process by process, and is particularly valuable to the management, as it reveals which operation in the processes has caused variation in the cost of the finished product. The figures are from the process sheets (Fig. 95) and are entered in the order that they arise. (The figures shown are fictitious.)

METHOD II

In Fig. 98 the first portion of the table shows how the cost per lb. of material is arrived at. The second portion shows the

additions for labour, process expenses, services overhead, and general overhead, together with the output for the four-weekly period.

The Cost of Services.—As an example of how service departments are allocated to the respective operations, details of the water, steam, and power service are given in Fig. 99.

FIG. 97.

ACCUMULATING COST PER LB. OF CORDITE

Period No. :

Processes.	M.D. (Cost per lb. at each Stage).		
	This Period.	Last Period.	Average for Previous Year.
	<i>d. per lb.</i>		<i>d. per lb.</i>
Acid Nitric—Guncotton	1·6334	1·5790	1·6874
" —Nitro-glycerine	1·7379	1·6800	1·7958
Prepared Cotton	6·5586	6·3400	6·7772
Nitrated Cotton	6·8472	6·6190	7·0754
Boiled Nitrated Cotton	7·2454	7·0039	7·4869
Finished ditto	8·1397	7·8684	8·4110
Stoved Guncotton	8·5940	8·3075	8·8805
Nitro-Glycerine	7·8003	7·5403	8·0603
Mixed Paste	8·4858	8·2029	8·7686
Incorporated Paste	13·0964	12·6598	13·5329

Finishings.	M.D.T. 5-2. Table showing Cost of Cordite in different forms of finish.						
	This Period.	Last Period.	Average for Previous Year.	This Period.	Last Period.	This Period.	Last Period.
	<i>d. per lb.</i>		<i>d. per lb.</i>				
Incorporated Paste from above	13·0964	12·6598	13·5329				
Pressed Cordite	14·1635	13·6914	14·6356				
Stoved "	14·3826	13·9032	14·8619				
Reeled "	14·7178	14·2272	15·2086				
Drummed "	14·9229	14·4255	15·4203				
Packed "	15·0000	14·5000	15·5000				

In the guncotton process, the rate per lb. in the first two items is found by dividing the value by the output.

In the next operation (nitration), the cost of nitration is £99; to this is added the whole of the cost of the prepared cotton of the previous operation (£18 15s.); and a proportion of the acid cost shown for the first operation, viz., $\frac{£6\ 15s.}{70,000} \times 100,000 =$

£9 12s. 10d. The total cost of this operation, £127 7s. 10d., divided by the output 140,000 lbs., gives a rate per lb. 0·2184d.

In the next operation (boiling), the output is less than the input; this is because some cotton was not fully boiled, and only the output shown was completed at the date.

Proceeding in the same way, the final cost of water, steam,

FIG. 98.

SUMMARY COST OF CORDITE

Period :

Items of Cost.	Rate per ton.			Consumption of Raw Materials and cost per lb. of Cordite.			
				This Period.		Last Period.	
	£	s.	d.	lbs.	d.	lbs.	d.
Raw Materials :							
Cotton ¹	50	0	0	0·4795	2·7188	0·4653	2·6282
Nitrate of Soda	5	0	0	0·9916	0·5824	0·9586	0·5630
Sulphuric Acid	5	0	0	1·3952	0·7475	1·3487	0·7226
Glycerine	100	0	0	0·1278	1·3690	0·1235	1·3234
Acetone	100	0	0	0·4000	4·2857	0·3867	4·1428
Jelly	10	0	0	0·0500	0·0536	0·3483	0·0518
Less Cr. Cotton & Fly					0·1502		0·1452
„ „ Nitre Cake					0·0512		0·0495
Total (cost per lb. for period)					d. 9·5556	d. 9·2371	
Items of Cost.	M.D.T. 5-2 Kind.						
	This Period.	Last Period.		This Period.	Last Period.	This Period.	Last Period.
	d.	d.					
Materials	9·5556	9·2371					
Direct Labour	0·7400	0·7153					
Factory Expense :							
Process :							
Supervision	0·1791	0·1731					
Indirect Labour	0·0483	0·0467					
W.S.P.	0·7080	0·6844					
Maintenance	0·7773	0·7514					
Miscellaneous	0·2508	0·2424					
Sectional :							
W.S.P.	0·2081	0·2012					
Laboratory Testing	0·2218	0·2144					
Maintenance	0·1131	0·1093					
Miscellaneous	0·3755	0·3633					
General	1·8221	1·7614					
Total cost per lb.	15·0999	14·5000					
	lb.	lbs.					
Output of Cordite	150,000	150,000					

and power per lb. (0.4768d.) is found, viz., this rate is the one applied (to the weight of guncotton prepared) to recover the cost of these services chargeable to guncotton. The same

FIG. 99.

WATER, STEAM, AND POWER SERVICE COSTS

Table showing Rate per lb. of Cordite to be Charged for these Services

Description.	Input of Product.	Output of Product.	£	s.	d.	Rate per lb.
Making Guncotton (Process I) :	lbs.	lbs.				d.
Nitric Acid		70,000	6	15	0	0 0231
Prepared Cotton		90,000	18	15	0	0 0500
Nitration of Cotton			99	0	0	
Prepared Cotton	90,000		18	15	0	
Nitric Acid	100,000		9	12	10	
£6 15s. × 100,000 - 70,000		140,000	127	7	10	0-2184
Boiling Cotton			62	5	0	
Nitrated Cotton	135,000		122	16	10	
£127 7s. 10d. × 135,000 ÷ 140,000		135,000	185	1	10	0 3290
Finishing Guncotton			59	0	0	
Boiled Cotton	138,000		189	4	1	
£185 1s. 10d. × 138,000 - 135,000		135,000	248	4	1	0 4412
Stoving Guncotton			20	0	0	
Finished Guncotton	135,000		248	4	1	
135,000 lbs. for £248 4s. 1d.		135,000	268	4	1	0-4768*
Making Nitro-glycerine (Process II) :						
Nitric Acid		60,000	23	5	0	0 0930
Nitro-glycerine :						
Nitration			110	0	0	
Nitric Acid	45,000		17	8	9	
£23 5s. × 45,000 ÷ 60,000		60,000	127	8	9	0 5097*
Making Paste (Process III) :						
Mixing Paste			1	0	0	
Nitro-glycerine	46,000		97	14	0	
£127 8s. 9d. × 46,000 - 60,000						
Guncotton (stoved)	98,500		193	13	10	
£268 4s. 1d. × 98,500 - 135,000		144,500	294	7	10	0 4890
Incorporation of Paste			60	10	0	
Paste	144,500		294	7	10	
144,500 lbs. for £294 7s. 10d.		150,000	354	17	10	0-5678*
Various Finishings (Process IV) :						
Pressed Cordite			46	0	0	
Incorporated Paste	150,000		354	17	10	
150,000 lbs. for £354 17s. 10d.		150,000	400	17	10	0 6414
Stoving Cordite	150,000	150,000	38	0	0	0 0608
Reeling Cordite	150,000	150,000	2	5	0	0 0036
Drumming Cordite	150,000	150,000	1	7	0	0 0022
Packing Cordite	—	—	—	—	—	—
Total. Water, Steam, Power Charge						0-7080

* These are the rates applied at the respective processes to recover the cost of the Water, Steam, and Power Services chargeable to them.

DAILY REPORT OF ISSUE AND PRODUCING PLANT DETAILS

FORM E

RESIN DEPARTMENT PRODUCTION RETURN

(Date).....19..

Batching.					Resin Making.				Remarks.		
Type of Resin.	No. of Batches.	Raw Materials Used (lbs.).			Type of Resin.	No. of Batches.	Catalyst.	No. of Still Hours.		Weight of Resin (lbs.).	
		Form- aldehyde.	Phenol.	Total Weight.					To Powder.	To Despatch.	
X	2	541	541	1082	X	2		44	578		

(These Daily Reports summarised on Monthly Summary similarly ruled, one Monthly Summary for each Resin.)

Expenses and Indirect Material Invoices are entered in an Analysis Purchase Journal; the monthly totals of the columns are posted to the Factory Expenses (Oncost) Schedule, a separate Schedule being compiled for each Process or Department.

Raw materials issued are listed daily, a monthly summary being compiled for each type of Resin. This summary also shows the production quantities for each type of Resin (Form B).

The Departmental Costs, apart from Raw Materials, are then gathered together on Forms C and D. The combined cost is then compiled on Form E from the information on Forms B, C and D.

PROCESS COST SHEET

FORM C.

From..... Date.....

S.O. No. (of Process) 1.	Product : Batching Resin.				Quantity Produced. 255,732 lbs.			Period of Costing : 4 Weeks ending Sept. 30th, 19...	
Items of Cost (other than Materials).	Quantity.	Price.	Value.			Unit.			
						Quantity.	Value.		
			£	s.	d.	lbs.	d. per lb.		
Wages (from Wages Analysis Summary)			30	0	0				
Oncost :									
Indirect Wages			1	12	6				
Overtime Allowance			1	15	0				
Plant Maintenance.									
Wages			3	10	0				
Materials			5	0	0				
Trades Shop			2	5	0				
Steam	126,593 lb.	62-500d. ^o / ₁₀₀	32	19	4				
Electricity Lighting	224 kwH.	0-7500 d.		14	0				
Insurance, Direct				12	6				
Rent, "			1	13	0				
Rates, "				10	0				
Process Production Cost (excluding Materials)			£80	11	4				
Apportionment of Process Cost.									
Product.	Wages.			Oncost.			Total.		
	£	s.	d.	£	s.	d.	£	s.	d.
Resin X		3	0		5	1			
" Y		18	0	1	10	4	2	8	4
" Z	28	19	0	48	15	11	77	14	11
As above	£30	0	0	£50	11	4	£80	11	4
							£80	11	4

* Applied as a rate per lb. in Final Cost Sheet, see Form E (Operating Costs).

It will be noticed the costs on Forms C and D are all the operating costs (wages and expenses) only; the materials are only brought to account in the Final Cost Sheet (Form E).

The manufacturing cost of wages and expenses is applied as a rate per lb. in Form E, under the heading "Operating Costs."

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PROCESS COST SHEET

FORM D.

From.....

Date.....

* Apportioned proportionately to still hours for each product.

† Applied at 2 rate per lb. in Final Cost Sheet, Form E (see Operating Cost section).

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FORM E.

COST SCHEDULE: RESINS (PACKED)

Four Weeks Ending.....19...

Type.	Resin X.			Resin Y.			Resin Z.		
Details.	Usage. Per lb.	Price. d.	Cost d. per lb.	Usage. Per lb.	Price. d.	Cost. d. per lb.	Usage. Per lb.	Price. d.	Cost. d. per lb.
<i>Raw Materials.</i>									
Formaldehyde	0-936	4-000	3-744						
Phenol	0-936	8-500	7-956						
Cresol									
Other Materials									
<i>Operating Costs.</i>									
S.O. No. 1									
Batching	1-872	0-090*	0-168						
S.O. No. 2									
Batching									
S.O. No. 3									
Resin Making	1-000	4-690*	4-690						
Production and Cost	578 lbs.		16-558						
	Quantity. lbs.	Rate. d. per lb.	Value. £ s. d.	Quantity. lbs.	Rate. d. per lb.	Value. £ s. d.	Quantity. lbs.	Rate. d. per lb.	Value. £ s. d.
<i>Resin for Moulding Powder.</i>									
Stock at 30th June, 19...	620	17-200	44 8 8						
Production (as above)	578	16-558	39 17 6						
	1198		84 6 2						
Stock at 30th Sept., 19...	480	16-558	33 2 4						
Used for Moulding Powder in this period	718	17-111	51 3 10						
<i>Resin for Sale.</i>									
Stock at Production . Add Packing (S.O. No.)									
Stock at									
Despatched in period									
<i>Add to Unit Cost of Resin for Sale.</i>									
† Works Overheads (at standard rate)			2-000						
Obsolescence (ditto)			0-784						

* These two prices from Forms C and D (Unit Value column).

† All factory expenses other than applicable to departments, the standard being based budget of total expenses and total estimated production.

EXAMINATION QUESTIONS

✓ The following details are extracted from the costing records of an Oil Refinery for the week ended September 30 :

Purchase of 500 tons of Copra			£20,000
	Crushing Plant.	Refining Plant.	Finishing
	£	£	£
Cost of Labour	250	100	150
Electric Power	60	36	24
Sundry Materials	10	200	—
Repairs to Machinery and Plant	28	33	14
Steam	60	45	45
Factory Expenses	132	66	22
Cost of Casks			750
300 tons of Crude Oil were produced.			
250 tons of Oil were produced by the refining process.			
248 tons of Refined Oil were finished for delivery.			
Copra Sacks sold			£40
17½ tons of Copra Residue sold			£1,100
Loss in Weight in Crushing			25 tons
45 tons of By-products obtained from refining process			£675

You are required to show the accounts in respect of each of the following stages of manufacture for the purpose of arriving at the cost per ton of each process, and the total cost per ton of the finished oil :

- Copra crushing process.
- Refining process.
- Finishing process, including casking.

Society of Incorporated Accountants and Auditors (Final).

2. What do you regard as the special features of process costs? To what classes of manufacture are they generally applied?—*Royal Society of Arts (Advanced).*

3. How would you deal with scrap material in process costs? Give a concrete example.—*Institute of Cost and Works Accountants (Inter.).*

4. The manufacturing operations of a Limited Company involve three distinct processes in connection with the same unit. The practice has been to prepare a Cost Sheet for the processes as a whole, based upon the completed unit. The Cost Sheet for January 1929 appeared as follows :

	Total. £	Cost per unit (pence).
Direct Wages : Process A	1,450	
" B	870	
" C	800	
	3,120	11·7
Raw Materials issued to		
Process A : 58,000 units	5,800	21·75
Machine Expenses : Process A	604	
" B	604	
" C	667	
	1,875	7·03
Factory Oncost	725	2·72
Cost of 64,000 units (C)	11,520	43·2
Deduct Waste, etc. 2,000 units (C)		1·4
Cost of Output of 62,000 "	11,520	44·6

The Cost Sheets in the form given are obviously unsatisfactory; the variations in cost per process cannot be viewed and the expenses attributable to waste and faulty production in the individual processes are not accurately dealt with.

You are instructed to prepare Process Cost Sheets for January 1929 similar in form to the above, but based on the output of each individual process.

For this purpose, the following Statement of Stocks is furnished :

	Process :	A.	B.	C.
Jan. 1, 1929, Stock received on hand (units)		10,000	6,000	18,000
„ 31, „ Received		58,000	54,000	56,000
		<u>68,000</u>	<u>60,000</u>	<u>74,000</u>
„ „ „ Delivered		54,000	56,000	62,000
„ „ „ Waste, etc.		4,000	2,000	2,000
		<u>4,000</u>	<u>2,000</u>	<u>2,000</u>
„ „ „ Stock on hand		<u>10,000</u>	<u>2,000</u>	<u>10,000</u>

You are informed :

- (1) That it is the practice to deliver to the next process all goods as and when completed and that no work has been done in any process upon units in stock at the end of the month.
- (2) That Factory Oncost may be taken as 1d. per unit for each process on the total of units delivered.
- (3) That Opening Stock of Process A and stock of raw material received into Process A may be taken as 2s. per unit.
- (4) That Opening Stock of Process B and units received into that Process may be taken at the average cost of units delivered by Process A during the current month, and similarly as regards units received by Process C from Process B.

Prepare Process Cost Sheets accordingly. Calculations need not be carried beyond one decimal place.—*Institute of Chartered Accountants (Final)*.

5. The Works Manager and the Sales Manager of a manufacturing firm are entitled to bonuses according to the results of the working of their respective departments.

The Works Manager's bonus is calculated as a percentage of the manufacturing profit each year, and for this purpose manufactured articles produced are to be credited to his department at an agreed price.

The Sales Manager's bonus is calculated as a percentage of the net profits each year, arrived at before charging the Works Manager's bonus.

The manufacture of the finished product comprises two processes : Process A in which the raw material purchased is treated, and Process B in which the material thus treated is worked up into the finished article.

During the year ended June 30, 1929, 3000 finished articles were produced, the agreed price at which they were to be credited to the Manufacturing department being £8 10s. per article, and the following figures represent extracts from the Firm's books for that period :

	£
Stocks at July 1, 1928 :— Raw Material	800
Work in Progress (Process B)	900
Finished Goods	4,500
Stocks at June 30, 1929 :— Raw Material	900
Work in Progress (Process B)	500
Finished Goods	5,000

	£
Purchase of Raw Material	10,200
Sales of Raw Material	2,200
Purchases of Material used in Process B	3,600
Manufacturing Wages; Process A £5,000; Process B	3,000
Sales of Finished Goods	31,500
Establishment and Distribution Expenses (including Depreciation)	8,100

You are required :

- (1) To raise accounts showing the amounts on which the bonuses of the respective Managers will be based for the above-named period.
- (2) To state the cost per ton of Raw Material taken by Process B after treatment in Process A, the output of Process A being 500 tons.

Note.—Works Oncost is to be brought into account at the rate of 10 per cent. of the Manufacturing Wages in Process A and 20 per cent. of the Manufacturing Wages in Process B.—*Institute of Chartered Accountants (Final).*

6. The information given below is extracted from the Cost Accounts of a Factory producing a commodity in the manufacture of which three processes are involved. Prepare Process Cost Accounts showing the cost of the output and the cost per unit at each stage of manufacture :

- (1) The operations in each separate process are completed daily.
- (2) The value at which units are to be charged to Processes "B" and "C" is the cost per unit of Processes "A" and "A" plus "B" respectively.

	Process A.	B.	C.
Direct Wages	£640	£1,200	£2,925
Machine Expense	360	300	360
Factory Oncost	200	225	240
Raw Materials consumed	2,400	—	—
	Units.	Units.	Units.
Production (gross)	37,000	—	—
Wastage	1,000	1,500	500
Stock, July 1, 1930	—	4,000	16,500
Stock, July 31, 1930	—	1,000	5,500

Society of Incorporated Accountants and Auditors (Final).

7. Prepare a Cost Sheet for any industry with which you are familiar, showing comparative figures at the end of four separate periods.—*Institute of Cost and Works Accountants (Final).*

8. How should by-products be dealt with in the cost records? What varying circumstances should decide the exact method employed?—*Institute of Cost and Works Accountants (Final).*

9. Where a product is put through several processes, the finished articles of one process become the raw material of the next. At what price should the transfer from process to process be made? Illustrate your answer by a *pro forma* account assuming cost of Process 1 to be £700, Process 2 £880 (including cost No. 1), and Process 3 £1,200 (including cost of Processes 1 and 2).—*Society of Incorporated Accountants and Auditors (Final).*

10. A certain product passes through five distinct processes at a factory before it becomes a finished article ready for sale. Each process is dealt with in a separate department, but in the fourth process some of the raw material is purchased and not obtained from the prior processes. State and explain your views as to the price at which the transfers from process to process should be made.—*Society of Incorporated Accountants and Auditors (Inter.).*

11. Set out the headings for a cost statement for process manufacture, with a valuable by-product.—*Institute of Cost and Works Accountants (Final)*.

12. The sale of scrap brings in a substantial surplus over the cost of collection. Should this surplus be used to reduce the expense of handling and storing materials or treated as an ordinary sale? Give reasons for your view.—*Institute of Cost and Works Accountants (Final)*.

✓ 13. Product A yields by-products B and C.

The joint expenses of manufacture are :

Materials £500, Labour £400, Oncost £450, Total £1,350.

Subsequent expenses are as follows :

	A.	B.	C.
Materials	100	80	90
Labour	120	70	85
Oncost	130	50	75
	<hr/> £350	<hr/> £200	<hr/> £250
The selling prices are	£2,100	£1,000	£900
The estimated profits on sales are	50%	50%	33½%

Show how you would apportion the joint expenses of manufacture.—*Society of Incorporated Accountants and Auditors (Final)*.

14. Draft a Cost Sheet for Mass Production Works with four operating departments designed to show the cost at each stage of manufacture, and the total cost of each unit of production. Utilise your knowledge of any such works with which you may be acquainted in answering the question.—*Society of Incorporated Accountants and Auditors (Final)*.

15. In certain factories the wastage of materials constitutes by-products. How would you deal with these in Cost Accounts where :—
(a) The by-product is of little value. (b) The by-product is of considerable value?

Society of Incorporated Accountants and Auditors (Inter.).

16. In the manufacture of a certain article breakages occur at various stages of manufacture.

- Discuss the treatment of such losses in the firm's cost accounts.
- Calculate the cost of breakage (if any) at the end of each process in the undermentioned case.

Assume that no expenditure has been incurred on the broken unit in the actual process where the breakage has taken place and the broken articles have no scrap value.

Process.	Total Additive Cost. d.	No. of Unbroken Units at End of Process.
A	200	20
B	340	17
C	180	15

Society of Incorporated Accountants and Auditors (Final).

CHAPTER XVII

PROCESS COSTS (*continued*)

COAL CARBONISATION PLANT COSTS

Introduction.—Many useful products are obtained from the carbonisation of coal and the distillation of by-products. It may be mentioned that a ton of coal burned in a domestic fire-grate results in the destruction of nine gallons of tar, eight lbs. of fertilising substances, three gallons of benzole and nearly 12,000 cubic feet of gas.

The processes described in this chapter are for the commercial manufacture of coke and the recovery of the by-products in a modern plant, and the description is of a plant carbonising 500,000 tons of coal a year. Coal is a mineralised form of vegetable matter, and contains carbon, hydrogen, nitrogen, oxygen, a little sulphur, and ash; *i.e.* it consists of carbon, ash, and volatiles. It is from the last-named that by-products are obtained.

The Processes Described.—Small, clean coal is placed in air-tight silica ovens, and, with a modern battery, heated for approximately 17 hours at a temperature of about 1,110° C., which transforms the coal into coke, the volatile matter being collected through a connecting pipe fixed to each oven.

The hot gas is condensed by cooling, "scrubbed," and reheated, whereby the by-products, tar, sulphate of ammonia, and crude benzole, are obtained. The coal gas, approximately 12,000 cu. ft. per ton of coal, thus stripped of its by-products, is used as fuel for heating the ovens, as power for driving gas engines, as fuel for boiler firing, and the surplus is used, or sold locally for town lighting purposes. The by-product processes will be referred to later.

The Cost of Materials. Calculating the Coal Equivalent per Product and Department.—Coal is the basic raw material for each product, and it is necessary to find the correct allocation, which is complicated by the fact that, after leaving the Coke Department, the coal has to be measured in gaseous form, and reduced to a weight equivalent.

The constituents of coal vary according to the part of the country whence it is obtained. The by-products vary at

different distillation temperatures, and according to the efficiency of the plant.

By measuring actual recoveries over a period of a year, a close approximation is obtained of the proportions in which products and by-products are produced per ton of coal carbonised, *e.g.* :

Per ton of Coal (2,240 lbs.)

70.0 per cent. coke.

9.5 gallons of tar.

8 lbs. of ammonia.

3.0 gals. of benzole.

11,850 cu. ft. of gas.

Knowing the gravity of the liquids, and the density of the gas, these quantities can be converted to a weight equivalent :

Approx. 192 gallons of tar	= 1 ton, hence 9.5 gallons	= 111	lbs.
" 255 " benzole	= 1 ton " 3.0 "	= 28	
" 1,000 cu. ft. of gas	= 37.5 lbs. " 11,850 cu. ft.	= 443	
70 per cent. coke	=	1,572	
Ammonia	=	8	
Total weight recovered			2,162
Balance of ton (loss)			78
			<u>2,240 lbs.</u>

There is always a loss in treating the coal of about 4 per cent., due to natural moisture. This moisture, driven off, is finally condensed, and the water absorbs the ammonia, forming ammonia liquor. When the ammonia is driven off and collected, the water (waste liquor) represents the 78 lbs. balance.

The water is used to quench the hot coke, and, therefore, this 78 lbs. is allocated to the Coke Department, thus giving the full total of 2,240 lbs. :

	lbs.	
Coke	1,650	} per ton.
Tar	111	
Ammonia	8	
Benzole	28	
Coal gas	443	
	<u>2,240 lbs.</u>	

Allocation of Coal Gas.—As many of the expenses are apportioned to the various products on the equivalent coal value, it is necessary to apportion further the coal gas used by the

works. The gas is measured by meters, or measuring instruments, to all the consumers, say, for example :

	Cu. ft.	Equal in lbs. to
Heating the ovens	6,000	224
Used for gas engines	225	8
„ boilers	625	24
Sold outside	5,000	187
	<u>11,850</u>	<u>443 as above.</u>

A further allocation of the 6,000 cu. ft. (224 lbs.) used for heating ovens has to be made. The ovens are heated to the proper temperature for the reception of coal, and residue gas is used as supplementary heat during carbonisation.

This heat being essential for the production of coke, and other products, it is equitable to distribute the 224 lbs. coal charge over every department, pro rata to the direct charge of coal against them, as follows :

FIG. 100.

PROCESS ALLOCATION SCHEDULE

	Per Ton. lbs.	* Add used for Ovens. lbs.	Total Coal Allocation. lbs.	Per cent. per Ton.
Coke	1,650	183	1,833	82
Tar	111	12	123	6
Ammonia	8	1	9	0.5
Benzole	28	3	31	1
Gas Engines	8	1	9	0.5
Boilers	24	3	27	1
Gas Sales	187	21	208	9
Heating Ovens*	224	—	—	—
	<u>2,240</u>	<u>224</u>	<u>2,240</u>	<u>100</u>

The importance of the last two columns in the above table is that coal carbonised is used as the basis for allocation for a number of important items of overhead, as will be explained later.

Wages—Direct.—In the coking industry, the processes are for recovery of the products, rather than manufacture in the usual sense of the word. The labours of the workmen are subordinate to the function of the chemical action in the various units of plant used in production. For this reason day-rates of wages are used instead of piece-rates. Direct wages relate to that class of labour employed in the direct process of recovery in every department. The plant is in constant operation day

and night throughout the year, except in the extreme case where it has to close down because of industrial depression.

Each day is divided into three shifts, and the workmen record their time by time-recording clocks. The direct-labour time is a constant factor, because, should a man be off work for any reason, his place is at once filled by drawing from the maintenance staff another who is familiar with the duties. For instance, the Benzole Department has three direct workers, so that each week the department must be charged with twenty-one shifts, irrespective of which men work them.

FIG. 101.

MAINTENANCE

Week Ending.	Coke.			Tar.			Ammonia.			Benzol.			Power.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Jan. 7	400	0	0	6	0	0	20	0	0	25	0	0	40	0	0
14	380	0	0	5	0	0	19	0	0	24	0	0	42	0	0
21	390	0	0	6	0	0	21	0	0	20	0	0	45	0	0
28	400	0	0	4	0	0	22	0	0	26	0	0	41	0	0
31	100	0	0	1	0	0	10	0	0	12	0	0	10	0	0
	1670	0	0	22	0	0	92	0	0	107	0	0	178	0	0

These figures are calculated from the Workmen's Time-Sheets, and the total,

The Wages Book is drafted on departmental lines, thus providing a separate total of direct wages for each revenue and non-revenue department, in the same manner as shown for Maintenance Wages in Fig. 101.

Should the last day of the month conflict with the weekly pay-day all that is necessary is to calculate $\frac{2}{7}$ or $\frac{3}{7}$, as the case may be.

Indirect Wages consist of general labour and maintenance labour wages, *e.g.* fitters, joiners, blacksmiths, and electricians. As maintenance labour during a shift may be engaged on work affecting more than one department, Maintenance Time Sheets are issued (Fig. 102) at the beginning of each week. The workman states, briefly, the nature of the work done. The foreman indicates the department to be charged. The cost clerk completes the lower analysis, which provides the weekly totals of time and wages. These totals are agreed with the Wages Book, which is independently made up from the clock cards.

Stores Materials.—The production cost accounts are only concerned with the amounts consumed (not purchased), and the value of production (not sales). In the works under review there are three Store Departments :

- (i) Manufacturing materials.
- (ii) Direct maintenance materials.
- (iii) General maintenance stores.

Manufacturing Materials.—These consist of sulphuric acid, lime, bicarbonate of soda, creosote oil, soda ash, and caustic

WAGES ANALYSIS

Gas.			Rectifica- tion.			Recovery.			Steam.			Main- tenance.			Total.		
£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
2	0	0	2	0	0	12	0	0	10	0	0	100	0	0	617	0	0
1	10	0	2	10	0	6	0	0	4	0	0	98	0	0	582	0	0
1	10	0	2	0	0	4	0	0	6	10	0	100	0	0	596	0	0
2	10	0	2	10	0	8	0	0	12	0	0	120	0	0	638	0	0
	10	0		10	0	2	0	0	6	0	0	60	0	0	202	0	0
8	0	0	9	10	0	32	0	0	38	10	0	478	0	0	2635	0	0

£2,635, must agree with the total maintenance in the Wages Books.

soda. They are used for extracting the ammonia and crude benzole from the gas. Soda ash and caustic soda are used for purifying the crude benzole.

The ratio of these materials to coal carbonised is known from experience, so that contracts for supplies for three, six, or twelve months can be placed for automatic delivery of the required quantity each week.

The cost clerk is advised of the weight of all materials received during each week (Fig. 103), and by adding the opening stock and deducting the closing stock the amount consumed is arrived at. The materials are usually in storage tanks, so the closing stock can be measured. By applying the contract price the cost of materials consumed is found.

Direct Maintenance Materials.—These are for renewals, and replacements of plant, etc., and can be charged direct to a specific department.

The procedure for co-ordinating the purchasing, and the stores control, is as follows: A list of requisitions, signed by

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FIG. 102.

MAINTENANCE WORK TIME-SHEET

WORKMAN'S TIME-SHEET							Rate.	Dept. Ref.	ORDINARY HOURS	HOURS OVERTIME	TOTAL EQUIVALENT
<i>For week ending 28 February, 19...</i> <i>Workman's No. : 39. Name : Tom Jones.</i> <i>Class : Electrician.</i>											
W. (brief detail of work)								C T	3 4	— 2	3 7
Th.								etc.			
F.											
S.											
Su.											
M.											
Tu.											
COST ACCOUNT ANALYSIS							A. Harris.				50
							FOREMAN				
DEPT.	R	C	T	A	B	P					
WED.		3	7				10				
THUR.											
FRI.											
SAT.											
SUN.											
MON.									CHECKED		
TUES.											
TOTAL							50		WAGES ABSTRACT		
SHIFTS											
MONEY											

the Works Manager, is sent to the Purchase Department, together with a control card, showing ordering quantity, ordering level, and minimum. After the placing of the purchase order, the control card is returned to the Stores Clerk showing :

1. Date ordered.
2. Order No.
3. Suppliers.
4. Delivery date.

On arrival of the goods, a stores received form is completed, sent to the Purchase Department for checking with the requisition and order, and with the invoice.

Fig. 103.

THE COAL DISTILLATION Co.					
GOODS RECEIVED					
No. 397.			Week ending 21 February, 19...		
Item No.	Quantity.	Date Received.	Description.	From	Invoice No. and Date.
	No. or Weight.				
1	1 ton	15/2/19...	B./C. Soda	Nat. Chem. Co., Ltd.	281 13/2/19...
2	5 tons	17/2/19...	Lime	X. Y. & Co.	285 15/2/19...
Signed B. STOCKWELL.					

At the end of the month the invoices are entered in an analytical Purchase Journal (see Fig. 104) from which the direct maintenance materials charge is taken to the Control Account in the Cost Ledger.

Fig. 104.

PURCHASE ANALYSIS JOURNAL FOR DIRECT MAINTENANCE MATERIALS

19...	Inv. No.	Name.	Total.	Coke.	Tar.	Amn.	Benzol.	Power.	Stores.	Etc
			£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	
Jan. 1	1	John Brown Steel shaft	210 0 0	210 0 0						
12	2	W. Smith & Co. Nuts and bolts	40 0 0						40 0 0	
14	3	P. Brown & Co. Acid	1000 0 0						1000 0 0	
15	4	T. Jones & Co. Pipes	60 0 0		20 0 0	20 0 0	20 0 0			
			1310 0 0	210 0 0	20 0 0	20 0 0	20 0 0		1040 0 0	

Note.—The general maintenance materials are issued from stores, and abstracted in a form similar to that shown for wages.

General Stores.—These are kept on the perpetual inventory system described in an earlier chapter (p. 55).

Overhead Charges.

(a) *General*: The bases of allocation in the Coking Industry are indicated for various items below:

Workmen's Insurance, Compensation, and Sick Fund.—Allocation proportionate to direct and indirect wages in each department.

National Insurance is a deduction from wages, definitely known.

Fire Insurance.—Proportionate to value insured in each department.

Electrical Breakdown Insurance.—As each item is usually specified, with values, on the policy, specific allocation is made.

Boiler Explosion Insurance.—Charged to steam service direct.

Rent, Laboratory Charges, Sundry Expenses affect the whole plant, and are allocated on the same basis as coal carbonised.

Administrative Salaries, Directors' Fees, Audit Fees, and Staff Superannuation are allocated on the basis of coal carbonised as calculated on p. 268.

Rates.—The usual method of floor space as a basis would be incorrect. The method used is to allocate on a capital basis for each section.

Depreciation is arrived at from the Plant Register, and charged in the usual way.

(b) *Service Departments*: The re-allocation of the cost of Service Departments to the Production Departments.

The Service Departments are:

- (1) Gas recovery apparatus.
- (2) Power supply.
- (3) Steam supply.
- (4) Maintenance and repairs (these have already been dealt with).

Recovery Expense.—The Recovery Department is of primary importance, as it embraces all the apparatus for withdrawing the gas from the ovens, and giving it sufficient pressure to overcome the resistance of the by-product plant. The pressure in the oven is insufficient to overcome the resistance

set up by various units of apparatus through which the gas has to pass. An exhauster is provided, and this with other apparatus is called the Recovery Department.

This expense is allocated on the same basis as the coal charge (as shown in Fig. 100) to the departments, *e.g.* tar, ammonia, benzole, gas engine, steam, gas sold.

Power.—This is allocated on the basis of the H.P.-hours in each department.

General Maintenance Labour is allocated on the same basis as the coal carbonised.

Steam.—The allocation of the cost of the steam service is a complicated and difficult matter. There are to be considered such factors as whether live or exhaust steam is consumed and measured; whether it is converted into mechanical energy, or utilised for process work; what is the temperature and pressure of live steam as compared with exhaust steam; and what heat is lost in transit. It is, therefore, necessary to co-operate with the engineer. The following is an allocation made by the engineer taking the above factors into consideration:

FIG. 105.

STEAM ALLOCATION

One boiler evaporating 3,600 gallons or 36,000 lbs. of water per hour.

Department.	lbs.	%
Benzole	2,250	6
Benzole rectification	6,750	19
Power (steam engines)	9,000	25
Recovery (exhausters)	11,000	31
Ammonia (dryers)	4,000	11
Ovens (decarbonising oven tops)	3,000	8
	<u>36,000</u>	<u>100%</u>

The Accounts.—Each day the despatch clerk prepares an advice showing particulars of all products despatched during the day to the distributing depots, or to purchasers. Each class of product is listed on a different coloured form. (See Fig. 107.)

From these an analytical Sales Book is entered up to show, at the end of each month, the total quantity and revenue of each particular by-product.

To check these totals, the cost clerk prepares a summary of all sales for the month, together with opening and closing

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FIG. 106.

THE
SUMMAR

Expenditure.					Revenue.						
COKE	Coal Direct Wages Materials Maintenance, Wages Stores Power Overhead Charges Depreciation	£	s.	d.	COKE BREEZE DUST	T.	C.	Q.	£	s.	d.
		7,380 200 — 400 520 220 400 1,600 £10,721	0 10 — 0 10 0 0 0 0	0 0 — 0 0 0 0 0 0		11,700 1,200 414	—	—	—	7,020 840 20 £7,880	0 0 0 0	0 0 0 0
TAR	Coal Direct Wages Materials Maintenance, Wages Stores Power Overhead Charges Depreciation	£	s.	d.	TAR	T.	C.	Q.	£	s.	d.
		540 — 40 100 60 40 20 200 £1,000	0 — 0 0 0 0 0 0 0	0 — 0 0 0 0 0 0 0		800	0	0	0	2,000 — — — — — — — £2,000	0 — — — — — — 0	0 — — — — — — 0
AMMONIA	Coal Direct Wages Materials Maintenance, Wages Stores Power Overhead Charges Depreciation	£	s.	d.	AMMONIA	T.	C.	Q.	£	s.	d.
		45 40 700 60 40 40 60 100 £1,085	0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0		220	0	0	0	1,100 — — — — — — — £1,100	0 — — — — — — 0	0 — — — — — — 0
CRUDE BENZOLE	Coal Direct Wages Materials Maintenance, Wages Stores Power Overhead Charges Depreciation	£	s.	d.	CRUDE BENZOLE	Gallons. 70,000			£	s.	d.
		90 10 200 40 60 100 20 120 £640	0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0		—	—	—	—	2,041 — — — — — — — £2,041	0 — — — — — — 0	0 — — — — — — 0

	Month.	Coal Carbonised.		Cost Price.	Department.	Profit		
		T.	C.			January.		
DRY		18,000	0	10/-	Coke	£ 2,841	s. 0	d. 0
					Tar	1,000	0	0
					Ammonia	15	0	0
					Benzole	1,401	13	4
					Power	83	0	0
					Gas	1,474	0	0
					Benzole Rect.	1,248	0	8
WET					Loss.	£2,421	0	0

The totals of the various items of Expenditure

DISTILLATION Co.

COST AND REVENUE

January, 19...

Expenditure.					Revenue.						
POWER SUPPLY	Coal	£	s.	d.	POWER SUPPLIED	Units. 18,000 at 6d.	£	s.	d.		
	Direct Wages . . .	45	0	0			450	0	0		
	Materials . . .	22	0	0							
	Maintenance, Wages	100	0	0							
	Stores	40	0	0							
	Power . . .	60	0	0							
	Overhead Charges . .	60	0	0							
	Depreciation . . .	40	0	0							
		£367	0	0			£450	0	0		
GAS	Coal	£	s.	d.	GAS SUPPLIED	Cubic Feet in 1000ths. 100,000 at 6d.	£	s.	d.		
	Direct Wages . . .	810	0	0			2,500	0	0		
	Materials . . .	6	0	0							
	Maintenance, Wages	-	-	-							
	Stores	1	0	0							
	Power . . .	2	0	0							
	Overhead Charges . .	100	0	0							
	Depreciation . . .	4	0	0							
		100	0	0			£2,500	0	0		
BENZOLE RECT.	Crude Benzole	£	s.	d.	MOTOR SPIRIT SOLVENT NAPHTHA CREOSOTE Loss	Re- cover.	Sales Price.	Gal- lonage.	£	s.	d.
	Direct Wages . . .	2,041	13	4		70%	1/3	49,000	3,062	10	0
	Materials . . .	10	0	0		10%	1/-	7,000	350	0	0
	Maintenance, Wages	100	0	0		10%	3d.	7,000	87	10	0
	Stores	6	0	0							
	Power . . .	10	0	0							
	Overhead Charges . .	-	-	-							
	Depreciation . . .	20	0	0							
		24	0	0							
		£2,211	13	4				£3,500	0	0	

ACCOUNTS

Cost Price.			Sales Price.		Recovery.	
To Date.	January.	Standard.	January.	Value.	Standard.	January.
	16/8		12/-			73.0%
	25/-		40/-			9.0 galls.
	98/8		100/-			27.5 lbs.
	2.7d.		7d.			3.9 galls.

should agree with the totals in the Financial Books.

stocks, and a cost sheet, which takes the form of a number of summarised manufacturing accounts, is prepared as in Fig. 106, to show the cost for the month of each process and the revenue credited. The profit (or loss) for the month is summarised by products at the foot of the sheet, together with the percentages of recovery.

Daily Check on Efficiency of Production.—The total production of each by-product is divided by the tonnage of coal carbonised. For this purpose, stock is taken at the end of each

FIG. 107.

GOODS DESPATCHED NOTE
BY THE COAL DISTILLATION CO.

No. 903.

26 Feb., 19...

Truck or Tank Number.	Description.	Gross Weight.				Tare.				Net Weight.				Depot or Consignee and Station.
		T.	C.	Q.	L.	T.	C.	Q.	L.	T.	C.	Q.	L.	
372	Crude Tar in drums													No. 4 Sales Depot
308	Ground neutral S./Ammonia in bags													No. 2 Sales Depot.

Remarks:

.....Despatch Clerk.

shift, this being done with the aid of a dip-rod, as the products are stored in tanks.

The Cost per Unit is obtained by dividing the expenditure incurred on each product by the number of units produced in each case. This should be compared with the cost of the previous month and of the previous year.

The Costs per Ton of Coal Carbonised.—In addition to the unit costs, it is advisable to follow the trend of each total class of expenditure, *i.e.* total wages, stores, or power produced, and to find the cost of each per ton of coal carbonised.

EXAMINATION QUESTIONS

1. Prepare a costing sheet for an industry with which you are familiar where process costing is carried out. Relate by diagram the cost accounts from which your information is collected, and illustrate briefly the relationship to the financial results.—*Institute of Cost and Works Accountants (Final)*.

2. In the Chemical Industries, the same manufacturing processes frequently yield more than one marketable product, the selling prices of

which are determined in the open market and are influenced greatly by the demand for such products day by day. For example, in producing Coal Gas, Coke and Tar are also produced as by-products. In such cases, can the cost of coal gas be ascertained? If so, in what way? If not, how is the selling price of coal gas to be fixed?—*Association of Certified and Corporate Accountants (Final)*.

3. In a factory where process costing is in use, the unit of measurement varies in different processes for the same article (e.g. in Process A the unit is weight, in Process B the unit is superficial area) and finally sold at a price per article. How would you deal with this problem in your costs?—*Institute of Cost and Works Accountants (Inter.)*.

4. The figures given below are taken from the Cost Accounts of various by-product departments of a Colliery Company. The Company is desirous of making a reasonable profit on the production of its by-products with a view to allowing the Coal Production Account a share in the profits on the coal used in obtaining the by-products. For this purpose a rate of profit of 10 per cent. on the total production of by-products is agreed upon. Show the profit or loss derived from each by-product, and what amount is transferable to the Coal Production Account:

Coke Ovens :	£
Cost of 75,000 tons of Coal	63,150
Coke Oven Expenses	14,790
Production of 46,500 tons of Coke	74,250
Benzole Plant :	
Cost of Creosote Oil	1,000
Benzole Plant Expenses	1,370
Benzole Production	6,120
Ammonia Plant :	
Cost of Sulphuric Acid	1,330
Plant Expenses	1,880
Ammonia Liquor Production	7,520
Sulphate of Ammonia Production	4,010
Tar Plant Production	3,100

Society of Incorporated Accountants and Auditors (Final).

5. A factory having its own gas-making plant utilises in its manufacturing processes the whole of the residual coke.

How would you determine the price at which to credit the gas factory for the coke so used?—*Institute of Cost and Works Accountants (Inter.)*.

6. Discuss the problem involved in the costing of products made by processes which also produce a large number of by-products.—*Institute of Cost and Works Accountants (Final)*.

CHAPTER XVIII

UNIT OPERATION COSTS

Application of the Method.—The details of Job or Terminal and Process Costing have been described in the preceding chapters, and the method dealt with in this chapter differs in that a series of operations are costed. This method is suitable where production is of a continuous nature, involving scrap, or waste, at various stages, and where, owing to the continuous flow of manufacture, and the difficulty of physically separating the scrap or waste arising from different batches, it is impracticable to cost the product by the batch, job, or process.

When the factory is operating on mass-production lines in this way, it happens that all operations are in process simultaneously, and the quantities passing through each operation, at one time, are in no direct relation to one another, which makes it almost impossible to arrange for manufacturing in batches.

Unit operation costs are an advantage also where articles or components have to be stocked in a partly finished stage, to facilitate the execution of special orders, or for convenience of issue for later operations.

Effective Control of Unit Cost at each Operation.—This is secured inasmuch as, by this method, a detailed measure of efficiency is provided. Thus, at each operation, not only is the cost per article shown, but the cost per article of labour and material, and the total cost per finished article, which has passed through all the operations.

Again, the effect of the cost of defective work on the cost per article is shown, as well as the cumulative effect at each operation of waste in relation to subsequent operations. The principle underlying Unit Operation Costing is that each individual operation is costed, and from this operation cost the unit cost per article is ascertained. The method is particularly convenient when articles have to pass through one or more common operations, and, later, need subsequent operations in order to meet the various special requirements of customers.

The Procedure : Example I. (Fig. 108).—In this example, it is assumed, in order to simplify the description, that the whole

quantity required is put in hand, and that the exact numbers passed as good at each operation are put through the next operation. This procedure would be impracticable under actual working conditions, but it will facilitate the explanation of the necessary calculations.

A simple Unit Operation Cost Sheet, dealing only with one element of cost, viz. direct labour, is shown in Fig. 108. It is a simple sequential statement of quantities entering into five operations of a process, drawn up to show the mathematical procedure of the system. The columns are numbered for reference in the following description :

FIG. 108.

UNIT OPERATION COSTS : EXAMPLE I (Labour only)

Production Divisors.				% of Rejects to net of each Operation.	Ratio figure per 100 for cost of Final Net.	Labour Costs.						
Operation.	Gross.	Re- jects.	Net.			Value. £ s. d.	Costs per 100.					
							On Gross of each Operation. s. d.	On Net of each Operation. s. d.	On Final Net of each Operation. s. d.			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)			
1st	100,000	25,000	75,000	33·33	200	50 0 0	1 0·00	1 4·00	2 0·00			
2nd	75,000	5,000	70,000	7 14	150	18 15 0	6 00	6 43	9 00			
3rd	70,000	5,000	65,000	7·69	140	87 10 0	2 6·00	2 8·31	3 6·00			
4th	65,000	5,000	60,000	8·33	130	54 3 4	1 8·00	1 9·67	2 2·00			
5th	60,000	10,000	50,000	20·00	120	25 0 0	10 00	1 0·00	1 0·00			
					100	235 8 4	6 6·00	7 4·41	9 5·00			

In columns 2, 3 and 4 of Fig. 108 the figures indicate that, during the period under review, 100,000 articles, or components, were put into process at the first operation, 25,000 were rejected, and 75,000 passed as good. Twenty-five thousand being 33·3 per cent. of 75,000, this percentage is recorded in column 5. The total wages paid as direct labour for this operation was £50 (column 7). The number good at the first operation was worked on at the second operation, with the result shown in line 2, namely, that 5,000 were rejected and 70,000 passed as good—the percentage of rejections to good being 7·14, and the wages paid £18 15s.

The Use of Ratio Numbers.—In column 6, which is described as the ratio figure per 100 for calculating the cost of the final net, the intention is to indicate the number required to be put in hand at each operation in order to provide the quantity

necessary to complete the order, which for this purpose is taken as 100. In the example given, it is evident that 100,000 articles have to be put into process at the first operation, in order to give 50,000 good productions at operation (5). The relationship of these two numbers is obviously 2 to 1, hence the figure in line 1, column (6), is shown as 200. Similarly, for the second, third, fourth, and fifth operations the respective relationships between the numbers put into process and the number finally completed (50,000) are :—150, 140, 130 and 120.

FIG. 109.

UNIT OPERATION COSTS : EXAMPLE II (Labour only)

Production Divisors.				% of Rejects to net of each Operation.	Ratio figure per 100 for cost of Final Net.	Labour Costs.			
Opera- tion.	Gross.	Re- jects.	Net.			Valuc.	Costs per 100.		
							On Gross of each Operation.	On Net of each Operation.	On Final Net of each Operation.
						£ s. d.	s. d.	s. d.	s. d.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1st	120,000	30,000	90,000	33·33	200	60 0 0	1 0·00	1 4·00	2 0·00
2nd	112,500	7,500	105,000	7·14	150	28 2 6	6·00	6·43	9·00
3rd	105,000	7,500	97,500	7·60	140	131 5 0	2 8·00	2 8·31	3 6·00
4th	130,000	10,000	120,000	8·33	130	108 6 8	1 8·00	1 9·67	2 2·00
5th	96,000	16,000	80,000	20·00	120	40 0 0	10·00	1 0·00	1 0·00
					100	367 14 2	6 0·00	7 4·41	9 5·00

The Procedure : Example II, showing Labour Cost when Quantities at each Operation are Unrelated.—As already mentioned, such a simple case as is outlined in Example I is never met with in practice, and the problem with which the cost accountant is faced is one where all the operations are being carried on simultaneously, and where the quantities being dealt with, at the different operations, bear no regular relation to one another. Such circumstances are illustrated in the Cost Sheet shown in Fig. 109, but, so that the method of calculating the various figures may be more easily followed, the figures in columns (5) and (8) are given as being the same in both Figs. 108 and 109. It is obvious that the figures in columns (9) and (10), being based on the figures in columns (5) and (8), will also be the same in both cost sheets.

In Cost Sheet 2 (Fig. 109) the relationship between the numbers put into process (120,000), and the numbers finally completed (80,000), and the ratio figures, is not as obvious as in

Cost Sheet 1 (Fig. 108), and, therefore, it is necessary to indicate how the ratio figures are in practice determined. The procedure is as follows : The percentages in column 5 are first worked out for all the operations. Then it is necessary to work backwards. The percentage at the last operation is added to the base of 100 to give the figures in column (6), viz. : 120. The percentage in column (5) at the previous operation is now applied to the figure in column (6), 120, and, by addition thereto, gives the figure for this operation in column (6), namely, 130, 8·33 per cent. of 120, added to 120. In a similar way, the other ratio figures in column 6 are determined, and the result is this chain percentage, or set of ratio figures. In column 7 are stated the sums paid as wages for direct labour at each operation ; by dividing these sums of money by the gross numbers in column (2), and multiplying by a hundred, the labour cost per hundred articles or components on gross numbers (column 8) is obtained. By dividing the same Wages Values by the net numbers good at each operation (column 4), and multiplying by 100, the labour cost per hundred on the net number (column 9) is found. By multiplying the gross cost per hundred articles in column 8 by the ratio in column 6 the labour cost per hundred on the numbers finally passed as good, column 10 is obtained. In other words, if it costs one shilling per hundred articles dealt with in the first operation, and, as indicated in column 6, it is necessary to put into process two, at this stage, for every one that is finally passed as good, it will be obvious that the gross cost of one shilling must be raised in this proportion, and that the full labour cost is twice a shilling or two shillings per hundred at this stage, which is the figure shown as the final net cost in column 10.

Information Deduced from Cost Sheet 2.—From the practical figures in the second cost sheet (Fig. 109) the following deductions can be made :

1. The direct-labour cost per hundred final articles, or components, is 9s. 5d. (column 10).
2. It is necessary to put into operation, at the first stage, two articles for every one completed (column 6).
3. That, at each operation, the cumulative effect on direct labour of the waste or defective components arising at subsequent operations is the difference between the labour on the net of each operation (column 9), and the labour on the final net (column 10).

4. The direct labour cost of waste is 2s. 11d. (column 10 minus column 8). (This is a partial measure of the permissible expenditure that may be incurred to lessen defective work.)

5. A basis for the valuation of direct labour in work in progress.

Valuation of Work in Progress.—The valuation of direct labour included in work in progress is based on the figures shown in columns 5 and 9, and is calculated as detailed in Fig. 110.

FIG. 110.

UNIT OPERATION COSTS (Work in Progress)

<i>Work in Progress</i>	
At end of 1st Operation	$= \frac{\text{Nos. in Progress}}{100} \times \begin{matrix} \text{s.} & \text{d.} \\ 1 & 4\cdot00. \end{matrix}$
At end of 2nd Operation	$= \frac{\text{Nos. in Progress}}{100} \times \begin{matrix} \text{s.} & \text{d.} \\ (1 & 4\cdot00 + 6\cdot43 + 7\cdot14\% \text{ of } 1\ 4\cdot00). \end{matrix}$ $= \frac{\text{Nos. in Progress}}{100} \times \begin{matrix} \text{s.} & \text{d.} \\ 1 & 11\cdot57. \end{matrix}$
At end of 3rd Operation	$= \frac{\text{Nos. in Progress}}{100} \times \begin{matrix} \text{s.} & \text{d.} \\ (1 & 11\cdot57 + 2\ 8\cdot31 + 7\cdot69\% \text{ of } 1\ 11\cdot57). \end{matrix}$ $= \frac{\text{Nos. in Progress}}{100} \times \begin{matrix} \text{s.} & \text{d.} \\ 4 & 9\cdot70. \end{matrix}$
At end of 4th Operation	$= \frac{\text{Nos. in Progress}}{100} \times \begin{matrix} \text{s.} & \text{d.} \\ (4 & 9\cdot70 + 1\ 9\cdot67 + 8\cdot33\% \text{ of } 4\ 9\cdot70). \end{matrix}$ $= \frac{\text{Nos. in Progress}}{100} \times \begin{matrix} \text{s.} & \text{d.} \\ 7 & 0\cdot17. \end{matrix}$
At end of 5th Operation	$= \frac{\text{Nos. in Progress}}{100} \times \begin{matrix} \text{s.} & \text{d.} \\ (7 & 0\cdot17 + 1\ 0\cdot00 + 20\% \text{ of } 7\ 0\cdot17). \end{matrix}$ $= \frac{\text{Nos. in Progress}}{100} \times \begin{matrix} \text{s.} & \text{d.} \\ 9 & 5 \end{matrix}$ which agrees with the total of Col. 10 in Fig. 109.

To arrive at the valuation of labour of work in progress at the end of the first operation, the numbers of articles in progress must be multiplied by the net labour cost at this operation. For those articles in process at the end of the second operation, it is obvious that the direct labour expended in respect of each hundred is the net cost at each operation through which the articles have passed, viz. 1s. 4·00d. plus 6·43d., and that inasmuch as these articles have passed through the second operation, the net cost, at the first operation, must be increased by the defective percentage at the second operation (7·14 per cent.). This gives the cost as 1s. 11·57d., as detailed in Fig. 110. Similarly for the third, fourth, and fifth operations, and it will be seen that the articles in process at the fifth operation are valued at 9s. 5d. per hundred, which agrees, as, of course, it must, with the total in column 10.

Once the above principles and procedure have been mastered, the Cost Accountant should have no great difficulty in applying them to meet the requirements of his particular problem.

Essential Requirements for the Method.—There are certain essential requirements which must be observed in order to put this method of costing into successful operation :

1. A list of standard operations numbered in sequence. In this connection one small difficulty that is constantly arising, namely, casual or repeat operations, has to be considered, as, for example, re-examination or extra cleaning. In view of the fact that this is not part of the regular sequence of work, the calculation of a defective figure for this operation, and its inclusion in the chain percentage, would vitiate the result. The proper treatment in such a case is to link up the expenditure at this casual, or repeat, operation, to the expenditure on the prior standard operation, and apply the defective percentage, after allowing for waste at both the standard and the casual operations, to the total labour expense so obtained.

2. Frequent and regular clearance of all waste. The frequency of the clearances will depend upon circumstances, and should preferably be, at least, daily.

3. Frequent and regular reports by standard operation numbers of :

- (a) Rejections or preventable waste (this in order to determine figures for columns 3 and 5).

- (b) Scrap other than rejections, that is, legitimate scrap. The reason for this is that the ratio figure is not affected by this consideration, when the calculations are being made on the basis of numbers, and not on the basis of weight.

4. It is frequently impracticable to count numbers at the various operations, and the output is weighed, or measured, and then converted into numbers for purpose of payment. It follows, therefore, as there will be slight variations in the thickness of the material, or in other dimensions, or in its specific gravity, provision must be made for :

- (a) Frequent check weighings of the articles, or components, in order to confirm or correct the conversion factor of weight to numbers, and, in addition, as a check upon the scrap returns, where legitimate scrap arises.

(b) Frequent check weighings and counts of quantities removed from machines with the lubricant adhering to them. The object here is to prevent fraud, as it is not unknown for a bucket of lubricant to be thrown into the component in order to depress the scales.

Overhead.—So far one element of cost only—"Direct Labour"—has been dealt with, and it is necessary to make a few observations as to treatment of Overhead.

In order not to complicate the problem unduly, it is assumed that overhead is charged to the product on a time basis, by means of the machine-hour rate. This being so, the absorption at each operation on the gross numbers is known, and it can be dealt with on precisely similar lines to direct labour—that is, by the application of the ratio figure at each operation. There is one point that requires special mention in this connection, and that is in the case of examination operations. Assuming that the cost of examination is treated as an overhead expense, it will still be necessary to show examination as an operation, and to show the numbers examined, rejected, and accepted, respectively, at this operation, because the percentage of rejections here has a vital effect upon the ratio figure, as rejections are, generally, heaviest at examination operations. In this case, there will be no money entry in the account, as the expense being dealt with as overhead has already been provided for.

Material.—The treatment of the material element is simple in the case illustrated in Cost Sheet 2 (Fig. 109), as it will only be necessary to apply the ratio figure at the first operation to the value of the unit of material at that operation. In practice, however, the problem is rarely so simple, and the determination of the unit cost of material calls for some consideration, especially where there is legitimate scrap such as webbing, turnings, etc., as well as defective or rejected components, or articles. In such a case it is necessary to calculate a new ratio figure, introducing the legitimate scrap at each operation where it occurs, as such legitimate scrap does not enter into the ratio figure for direct labour.

The system described was introduced by Sir Reginald Townsend and developed by Mr. G. H. Clamp, F.C.W.A., who has contributed this chapter.

EXAMINATION QUESTIONS

1. The manufacture of an article is carried out on mass production lines, and consists of five operations.

The following are details for a period, the operation numbers indicating their sequence :

Operation number.	Gross numbers of articles worked upon.	Numbers defective at each operation.	Total wages paid for each operation.		
			£	s.	d.
1	5000	300	19	11	8
2	4500	500	33	6	8
3	6000	300	35	12	6
4	3500	400	32	5	10
5	5000	500	18	15	0

You are required to determine from these figures the labour cost per 100 articles for the period, having regard to the effect at each operation of the cumulative percentage of defectives at the subsequent operations. Accuracy to the nearest penny will suffice.—*Royal Society of Arts (Advanced)*.

2. By what method would you cost an article, the manufacture of which went on uninterruptedly, and where wastage occurred at various stages of manufacture and assembly?—*Royal Society of Arts (Advanced)*.

3. In the preparation of periodical cost figures for repetition work, how would you indicate clearly the causes of fluctuations? Illustrate your answer with two examples.—*Institute of Cost and Works Accountants (Final)*.

4. A number of articles varying in size and style can only be completed after an interval between each process. The articles may be batched for certain processes, but the time involved varies for each article, and in some cases is of short duration. How would you ascertain the cost of each article when complete?—*Institute of Cost and Works Accountants (Final)*.

5. Machine parts requiring ten operations to complete are required in large quantities, and in every operation defective work is inevitable. How should they be put in hand in the shop in order to ensure accurate costing and replacement of scrapped parts?—*Institute of Cost and Works Accountants (Intermediate)*.

6. A product involving the assembly of a number of small components is manufactured under the batch method, the numbers put in hand at the first operation of each component being sufficient to provide for the anticipated defectives and to allow for the final assembly of the numbers required in the batch. The excess numbers at the first operation vary for the different components and are based on past experience. How would you propose to ascertain the cost of the defective parts?—*Institute of Cost and Works Accountants (Final)*.

CHAPTER XIX

UNIT OR SINGLE (OUTPUT) COSTING

SINGLE (Output) Costing, or Unit Costing, is a method of costing by the unit of production, where manufacture is continuous, and the units are identical, or can be made so by means of ratios. It may be applied to particular processes in conjunction with Process Accounts, or to Operation and Batch Costing.

The method is used in undertakings where there is a uniform product, of which there is a natural unit of cost. The work in such undertakings does not lend itself to Job Costing.

In most cases, the general accounts can be arranged in such a way that the Manufacturing, or Working, Account furnishes the total cost, and the detailed unit costs, when the expenditure is brought into relation with the output.

The accounts are designed to show :

- (a) The total cost of the output for any required period.
- (b) The unit cost in detail under the respective expense headings.

Examples of industries in which the method may be used, together with a suggested unit of cost, are :

Industry.	Unit Cost.
Steel works . . .	per ton of steel.
Quarries . . .	per ton of stone.
Collieries . . .	per ton of coal raised.
Milling . . .	per sack of flour.
Breweries . . .	per barrel of beer racked.
Gold mines . . .	per ounce of gold recovered or per ton of ore crushed.
Copper mines . . .	per ton of copper.
Paper-mills . . .	per ton (or per lb.) of paper.
Textile factory . . .	per yard of material.
Envelope-making . . .	per thousand envelopes.
Brick-making . . .	per thousand bricks.
Spinning mill . . .	per lb. of yarn.

Industry.	Unit Cost.
Electro-plating	. per sq. inch plated (or per article if uniform).
Biscuit-making	. per cwt. of biscuits.
Lubricating Oil	. per ton or per gallon of oils blended.

The unit selected may be weight, measurement, or the filled container (box, barrel, sack, bag, etc.).

Departmental Application.—Although used for undertakings having a single unit of output, the method may be applied in factories where separate articles are made in different departments. Also where distinct operations, or processes, are separated departmentally, but, in these instances, departmental or process costs are usually adopted in conjunction with departmental output. (See for example Foundry Costs, page 312.)

The Procedure.—Expenditure for inclusion in the costs is often obtained by arranging the required divisions in the Financial Accounts. There has been, however, considerable growth in the practice of making the primary accounting in the cost accountant's department. This has considerable advantage as by dealing with primary data closer analysis and recording is possible. Schedules of various constituents of cost are prepared, and these may form a basis for compilation of Control Totals Accounts to provide the requisite medium for interlocking or reconciling with the Financial Accounts. It is usual to make up cost-sheets for short periods, such as a week, fortnight, or month.

From the nature of the work in many industries of the kinds mentioned, a Raw Material Account or Accounts can be operated conveniently in conjunction with the Manufacturing (or Working) Account. (See Fig. 111.)

The summary accounts are ruled with additional columns to show the detailed cost per unit. A column for percentage cost is often included.

Abstracts of the materials used, quantity, and value are prepared. The material is priced at cost on the "first in, first out" principle, or on the average cost. The average is made on the sum of the balance in stock, and the next delivery.

As in Process Costing, there occurs, sometimes, a loss of weight, or volume, in process. Such a loss in quantity (as distinct from value) should be shown in the account in total and as a cost per unit, as to which see "Scrap," page 250.

Wages are debited from the analysis summary.

Overhead Expenses appropriate to the cost period are debited. For this purpose expenses are often summarised in suitable schedules, particularly when actual figures for each period are used. When the cost sheets are prepared for short periods, such as weekly or monthly, this procedure is convenient, but it sometimes gives rise to some delay in the compilation of the cost sheet. This is overcome in factories by the adoption of carefully calculated rates of recovery of overheads based on the assessed expenses for the year. Usually in such cases the figures of the preceding year, suitably adjusted for trend of both output and amount of expenses, are used. Appropriate alteration of the rates may be made from time to time if they are found to be, in fact, too high or too low. Whether this is so will be revealed by the Overhead Expenses Control Accounts as already described in Chapter XV.

It should be noted that more than one Overhead rate may be employed, especially where greater precision can be obtained by recovering particular groups of expenses by separate rates, as is often the case.

Example of Manufacturing Accounts.—The following accounts show the use of Raw Material, Manufacturing, and Trading Accounts for a factory making envelopes by machinery.

Comparative Costs.—By preparing summaries monthly, or for successive weeks for a year, the unit costs can be compared and used by the management for following the trend of cost for control purposes. The percentages in the Manufacturing and Trading Accounts are particularly helpful. In the latter account, it is the percentage to sales that is shown. Suggested forms

FIG. 111.

ENVELOPE-MAKING FACTORY ACCOUNT

Raw Material

Flat Paper—Superfine, Angle, Grade 9

Dr.						Cr.					
19...		Rms.	Fo.	£	s. d.	19...		Rms.	Fo.	£	s. d.
Feb. 1	To Stock	40	b/d.	13	17 0	Feb. 22	By Issues to				
" 22	" Purchases	930	J7	209	19 0	"	Machinists	900	J8	369	0 0
						"	as abstract	70	c/d.	23	15 0
						"	" Stock				
		970		£223	15 0			970		223	15 0
19...											
Mar. 1	To Stock	70	b/d.	23	15 0						

Note.—Similar stock accounts for other grades of materials.

Manufacturing Account

for the month ending February 28th, 19...

Dr.

Cr.

Output 16,000 thousands.

19...		Cost per M. d.	£	s.	d.	19...		Fo. c/d.	£	s.	d.
Feb. 28	To Materials :					Feb. 28	By Trading A/c.		1400	0	0
	Rms. M.						Loss in				
	G.9 900 7,200	10	300	0	6		Punching				
	G.12 700 5,600	12	280	5	0		(... lb.) =				
	G.16 400 3,200	24	320	10	0		1% .		-	-	-
		16,000	900	15	6		" Spoils in				
							Making (80				
							M.) = 1%		-	-	-
"	" Direct Wages :					"	" Sales of Cut-				
	Punchers . . .	1-0	65	18	0		tings and				
	Machinists . .	4-0	264	2	0		Waste (.....				
		5-0	1230	15	6		cwt.).			15	6
"	" Overhead (Fac-										
	tory) :										
	Fixed—										
	Depreciation £35										
	Rent, etc. 61	1-4	96	0	0						
	Variable—										
	Labour . . . 38										
	Power . . . 12										
	Ind. Mat. . . 7										
	Other. . . 17										
		1-1	74	0	0						
		7-5	£1400	15	6				£1400	15	6
	Av. works cost .	21-0									

Trading and Profit and Loss Account

February 19 ..

Dr.

Cr.

19...		M.	£	s.	d.	19...		M.	£	s.	d.
Feb. 1	To Envelope Stock					Feb. 28	By Sales .	22,670	3400	10	0
	b/d.	20,000	2650	7	6						
Feb. 28	" Manufactured										
	per Mfg. A/c.	16,000	1400	0	0						
	b/d.	36,000	4050	7	6						
"	Less Stock on										
	hand . . .	13,330	1500	0	0						
"	Cost of Sales.	22,670	2550	7	6						
"	" Gross Profit										
	c/d. . . .		850	2	6						
			£3400	10	0				£3400	10	0
	To Administrative	% on	£	s.	d.	19...	By Gross Pro-	% on	£	s.	d.
	Expense	Sales.				Feb. 28	fit b/d. .	Sales.			
	" Selling Ex-	8-5	289	0	0			25	850	2	6
	pense	7-0	238	1	8						
	" Distribution	3-0	102	0	4						
	Expense	6-5	221	0	6						
	" Net Profit for										
	month . . .		£850	2	6				£850	2	6

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FIG. 112.

SCHEDULE OF COMPARATIVE COSTS

Items.*	Month of		Same Month last Year.		Total to date since Stocktaking.		Total same Period last Year.	
	£ s. d.	Cost per Unit.	£ s. d.	Cost per Unit.	£ s. d.	Cost per Unit.	£ s. d.	Cost per Unit.
Raw Materials :								
1.....								
2..... etc.								
Manufacturing A/c. :								
(detailed Works Expenses)								
Trading A/c. :								
(detailed expenses of								
(a) Administration								
(b) Selling								
(c) Distribution)								
Net Profit								
Output in Units								

* These are the details as shown in the Manufacturing and Trading Account in the Cost Ledger.

for comparison of costs are shown in Figs. 112 and 113, and alternative forms are given in Figs. 117 and 142.

Specimen Accounts and Cost Sheets for several types of undertaking are given in this chapter. Their form is optional

FIG. 113.

SERVICE DEPARTMENTS

Comparative Costs

		Week Ending: 19...				Columns Repeat for each week.
		Production.....Tons				
A/c. Ref. No.	Services.	Hrs.	£	Average cost per		
				Hr.	Ton.	
20	Electric Power					
21	Boiler House					
22	Compressed Air					
23	Water					
24	Transport					
25	Buildings					
26	Coal					
27	Stores					
28	Testing and Laboratory					
29	Acid Recovering					
Total						

FIG. 114.

PAPER MILL COST SHEET

Mill. No. :

Date, 4 July, 19...

Production Order No. 962 for Parchment Writing Paper.

No. of Engines : 48 in 4 Chests.

Quantity $4\frac{1}{2}$ tons.

Formula for Materials for the Order : (see note at foot).

Chests No.	Engines of Raw Materials.					
	No. 1 Rag.	No. 2 Rag.	Special Rag.	Wood.	Broken Paper.	Etc.
1	5	2	2	1	2	
2	5	2	2	1	2	
3	5	2	2	1	2	
4	5	2	2	1	2	
Total Engines	20	8	8	4	8	

		Cwt.	Qr.	lb.	s.	d.	£	s.	d.	£	s.	d.
Materials :												
Engine-Material.												
20	No. 1 Rag . . .	40	0	0	27	6	55	0	0			
8	No. 2 „ . . .	16	0	0	17	0	13	12	0			
8	Spec. „ . . .	16	0	0	19	0	15	4	0			
		72	0	0			83	16	0			
8	Papers . . .	16	0	0	15	0	12	0	0			
4	Wood . . .	8	0	0	18	6	7	8	0			
48	Total . . .	96	0	0								
Add for loss on boil of rags .		10	3	5			12	11	5			
Less Waste in machine sale		4	0	24			3	3	1			
										112	12	4
										14	2	8
Rag Sorters' Wages . . .												
Other Materials :												
	Caustic 635 gals. . .	4	0	15	14	3	2	18	11			
	Antichlor. 120 „ . . .	1	1	24	14	0		6	6			
	Bleach 120 „ . . .	1	1	6	6	9		9	6			
	Alum 12 pails . . .	1	1	12	5	6		2	0			
										3	16	11
	Starch 100 lbs. . .		3	16	25	6	1	2	10			
	Resin Size 40 qts. . .							16	8			
	Soap . . .		2	24	50	6	1	16	0			
										3	15	6
	Gelatine . . .	84	3	2	40	0				8	9	7
										142	17	0
Wages as per abstract . . .										152	4	5
Fuel Coal . . .										8	0	0
Mill expenses as per schedule . . .										72	0	0
Output: Actual weight 84 cwt. = 88.3% of engine-material. Cost per lb. $9\frac{1}{2}d$.							Making cost			£375	1	5

Note.—(1) Engines and chests are containers of raw materials, twelve engines to one chest. (2) The total cost, divided by the weight of output, gives the cost per lb. of paper made.

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Fig. 115.

COLLIERY COST SHEET

Name of Pit :

Week Ending :

Days occupied :			Coal raised : tons.			Last week :tons.		
	This week.			Last week.				
	Totals.			Cost per Ton.				
<i>Underground—</i>								
<i>Wages—</i>								
Getting								
Transport								
Deputies and Checkers								
Roads and Faults .								
			£		£		£	
<i>Expenses—</i>								
Pit Props								
Stables								
Stores								
Sundries								
<i>Cost per ton</i> .			£		£		£	
<i>Surface—</i>								
<i>Wages—</i>								
Labour								
Joiners and Fitters .								
Pumping, Winding,								
etc. . . .								
Weigh-house								
<i>Expenses—</i>								
Stores								
Repairs								
Transport								
Sundries								
<i>Cost per ton</i> .			£		£		£	
<i>Establishment and Other</i>								
<i>Expenses—</i>								
Royalties								
Rent and Rates . .								
General Expenses—								
(In detail)								
Insurance								
Capital Sinking Fund								
<i>Cost per ton</i> .			£		£		£	
<i>Total Cost per ton</i> .			£		£		£	
<i>Average Price realised</i>								
<i>per ton</i>			£		£		£	

Note.—The output stated on the form is the gross tonnage raised. Some of this is used in the colliery and some is supplied free to employees, the cost of which is included in the colliery expenses.

FIG. 116.

STEEL ROLLING-MILL

Summary of Production and Costs

Week ending: 19...

Department.	Production.		Total Expense.			(Columns Repeat.)
			W.E. :			
	Tons.	Hours Worked.	£	Average per		
				Hr.	Ton.	
Hot Mill 1 . . .						
„ 2 . . .						
Total Hot Mills .			£			
Cold Mill 1 . . .						
„ 3 . . .						
„ 4 . . .						
Total Cold Mills .			£			
Pickling Shop 1 . .						
„ „ 2 . . .						
Total Pickling .			£			
Annealing 1 . . .						
„ 2 . . .						
„ 6 . . .						
Total Annealing .			£			
Paring and splitting .						
Cutting to length .						
Shearing . . .						
Hardening and tempering . . .						
Polishing . . .						
Grinding . . .						
Warehouse . . .						
Delivery Charges .						
Total Miscellaneous Processes .			£			
Steel Service . . .						
Scrap „ . . .						
Total Steel Service .						
Grand Total .			£			

Note.—This is a total cost statement. A similar cost sheet is prepared with a column for each heading of expenses, e.g. Indirect Wages, Coal Used, Stoves, Repairs, Services, etc., a special sheet for each week.

FIG. 118.

CANNED FOODS

Form of Cost Summary for 48,000 1 lb. tins of "Quick" Meals

	Nomi- nal Weight.	Weight Used.	Price per Unit.	De- tails.	Total Cost.	Cost per Dozen Tins.
	Lbs.	Lbs.		£	£	s. d.
<i>Ingredients.</i>						
Meat						
Potatoes						
Carrots						
Peas						
Gravy						
	49,000					
<i>less Residuals.</i>		Weight or Quan- tity.				
Meat—Bones, Fat, Gristle, Kidneys, Suet, Sweep- ings, Muslin Bags, Blood and "Turn of Scale." ... % on usage						
Potatoes—Peelings and "Turn of Scale." ... % on usage						
Carrots—Peelings and "Turn of Scale." ... % on usage						
Peas—Rejects, Sweepings and "Turn of Scale." ... % on usage						
<i>Total Tins filled</i>	49,000					
<i>less Sale of imperfect tins</i>	1,000					
<i>Total usable tins</i>	48,000					
<i>Labour.</i>						
Handling Ingredients						
Preparing Ingredients						
Filling Tins						
Exhausting Tins						
Retorting Tins						
Lacquering Tins						
Labelling Tins						
Packing into Cases						
Wiring and Nailing Cases						
Stacking Cases						
<i>Supplies.</i>						
Tins		49,500				
<i>less damaged (...%) and sold for scrap</i>		500				
		49,000				
Lacquer and Thinnings.						
Labels		50,000				
<i>less wastage (...%)</i>		2,000				
		48,000				
Cases		1,008				
<i>less damaged (...%) and sold for firewood</i>		8				
		1,000				
Packing Sundries : Nails, Wires, Stencils, etc.						
<i>Departmental Overheads</i> at ... pence per dozen						
<i>General Works Overheads</i> at ... pence per dozen						
<i>Administrative Overheads</i>						

- Notes.—1. In practice, full details of Residuals, Packing Sundries, etc., would be shown, item by item.
2. The "Turn of Scale" is the fractional amount which is put into the tin over and above the theoretical quantity.
3. Subsidiary schedules could be attached showing details of recipe, preparation of gravy stock, etc.
4. Further columns could be added for comparisons with previous periods, etc.
5. A "Remarks" column could record such information as causes of excessive wastage, etc.

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FIG. 115.

COTTON WOOL

Form of Cost Summary for the production of 100,000 lbs. of Bleached Cotton Wool

	Price.	Unit.	Details.	Total Cost.	Cost per 100 lbs.
101,770-0 lbs. Grey Cotton				£	
11,124-7 Bleaching Loss 11%, Loss in Bleaching					
90,575-3					
20,535-8 lbs. Bleached Cotton					
111,111-1					
11,111-1 Loss 10%, Loss in Carding ... waste sold for					
100,000-0 lbs.					
Labour. Scutching					
Carding					
Packing					
Baling					
Maintenance					
Supplies. Interleaving Paper		Quantity.			
Packaging Paper					
Labels					
Headman					
Twine					
MEL Overheads at . . . pence per lb.					
Administrative Overheads					

- Notes.—1. Further columns could be added for comparisons with previous periods, cost per lb., etc.
 2. A "Remarks" column could record such information as causes of excessive process losses, etc.
 3. Overheads based on throughput. In general it will be advisable to show a separate rate for "fixed" expenses and "variable," as by doing so the costs are more correctly presented.

and usually depends on the ideas of the cost accountant in control.

Cost Sheets.—These are prepared for the use of the management, and, consequently, they must include all the essential details which will assist the manager in checking the efficiency of production. In addition to the simplified forms given in this chapter, reference may be made with advantage to those shown for Process Accounts (Figs. 95, 106). Explanatory comments necessary are given with each Cost Sheet illustrated, viz. Paper-mill (Fig. 114); Colliery (Fig. 115); Steel Rolling-mill (Fig. 116); Expenses (Steel Mill) (Fig. 117); Machine Envelope-making (Fig. 111). (See also Foundry Costs, Fig. 126.)

EXAMINATION QUESTIONS

1. The following balances have been abstracted from the books of the Merton Colliery Company, Limited, in respect of the month ended on December 31, 1930 :

	£
Stock of Coal at December 1, 1930	750
Wages paid : Colliers	3500
Underground	1600
Surface	1000
Timber	460
Stores	120
Royalties	650
Depreciation (for the month)	650
Repairs	240
Stable Expenses	110
Rent and Rates	200
Pithead Office : Salaries	100
Postages, Telephones, etc.	30
Insurances	200
Heating and Lighting	50
Selling Expenses : Agency Charges	300
Advertising	50
Office Sundries	40
Bank Charges	50
Discounts, Dr.	250
Bad Debts	150
Rents of Cottages, Cr.	100
Coal Sales	11,000

The value of the stock of coal at December 31, 1930, is £900.

Coal Stock at the beginning was 1000 tons (£750).

Coal Stock at the end was 1200 tons.

Sales for the period were 8800 tons.

Calculate pithead cost and total cost, per ton of production; and prepare a statement for the information of the Board at their next monthly meeting exhibiting the result of the working.—*London Chamber of Commerce (Senior)*.

2. Draw up a summary cost statement for any product you select and give such information therein as you think necessary for the management.—*Royal Society of Arts (Advanced)*.

3. From the following information prepare a monthly Cost Sheet of the Sand-Lime Brickworks, showing cost and profit per M bricks. (Note—M = 1000.)

Materials used : Lime : 895 tons at 50s. per ton.
 Coal : 820 tons at 30s. per ton.
 Sand : 1s. per M bricks made.
 Stores : £632 10s.

Labour : Sand Digging and Running, £500.
 Brick-making, £2000.

Factory Oncost : 25 per cent. of direct charges.

Office Oncost : 10 per cent. of Factory Cost.

Bricks sold : 3500 M at 55s. per M.

Stock of bricks at beginning of month : 100 M.

Stock of bricks at end of month : 600 M.

Society of Incorporated Accountants and Auditors (Inter.).

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4. The following particulars relate to the working of a colliery for one month :

	£	s.	d.
Wages	5,166	13	4
Stores	250	0	0
Timber	291	13	4
Repairs and Renewals	150	0	0
Depreciation	260	8	4
Tramways	141	13	4

Total Coal raised, 10,000 tons.

The colliery company own the freehold, and the annual value of the property is taken at £2,400. The total administration expenses for the month were £2,000, which included Selling and Distributing Charges.

You are required to make any necessary allocations (stating the bases used) and to prepare the Colliery Cost Sheet for the month showing the cost per ton of coal raised.—*Society of Incorporated Accountants and Auditors (Inter.)*.

5. The Excelsior Manufacturing Co., Limited, deal in a Speciality selling at £40 per unit. The Trading and Profit and Loss Accounts of the Company for the year ended 31st December, 19... are as follows :

TRADING ACCOUNT

19...	19...
Jan. 1. To Stock . . . £4,000	Dec. 31. By Sales . . . £30,000
Dec. 31. „ Materials . . . 7,750	„ Stock . . . 2,000
„ Wages . . . 12,000	
„ Gross Profit . . . 8,250	
<u>£32,000</u>	<u>£32,000</u>

PROFIT AND LOSS ACCOUNT

19...	19...
Dec. 31. To Office Ex- penses . . . £3,000	Dec. 31. By Gross Profit . . £8,250
„ Depreciation . . 1,500	
„ Directors' Fees . . 750	
„ Net Profit . . . 3,000	
<u>£8,250</u>	<u>£8,250</u>

Prepare, in detail, a Cost Sheet showing the cost of production and distribution per unit.—*Society of Incorporated Accountants and Auditors (Final)*.

6. Select an industry and set out, as fully as possible, a form of final cost and include therein sufficient information to permit of a selling price being obtained.—*Institute of Cost and Works Accountants (Inter.)*.

7. Prepare a statement showing the assembly of the cost sheet suitable for one of the following :

- A one-pound fancy cardboard box of assorted chocolates.
- A two-pound jar of marmalade.
- A seven-pound bar of soap.

Institute of Cost and Works Accountants (Final).

8. A factory requiring timber, purchases in bulk and stores for seasoning. Separate stores are used for boards, after sawing and planing to thickness, from which they are drawn into shops for manufacture of repetition parts. Cutting, sawing, planing, and spindling machines are in use. Describe the method of costing you would advocate.—*Institute of Cost and Works Accountants (Final)*.

9. Draft a monthly report to the Directors, showing all information which you consider should be given by the Cost Accountant. Give your answer as fully as possible.—*Institute of Cost and Works Accountants (Final)*.

10. In assembling costs the margin between works cost and selling price is available for :

- (a) Selling and Distribution Costs.
- (b) Administration Costs.
- (c) Profit or Loss.

These items are sometimes expressed as a percentage on selling prices. What objections may be raised to this method and what alternatives are available?—*Institute of Cost and Works Accountants (Final)*.

11. In the process of electro-deposition a number of jobs are treated simultaneously in the deposition baths. It is not practicable to charge the labour involved direct to the jobs. How would you propose to cost the work done?—*Institute of Cost and Works Accountants (Final)*.

12. The following extract of costing information relates to Commodity A for the six months ended June 30, 1928 :

Purchases—Raw Materials	£30,000
Direct Wages	25,000
Rent, Rates, Insurance, and Works Oncost	10,000
Carriage Inwards	360
Stock—January 1, 1928 :	
Raw Materials	5,000
Finished Product—1,000 tons	4,000
Stock—June 30, 1928 :	
Raw Materials	5,560
Finished Product—2,000 tons	8,000
Work in Progress, January 1, 1928	1,200
Work in Progress, June 30, 1928	4,000
Cost of Factory Supervision	2,000
Sales—Finished Product	75,000

Advertising, Discounts Allowed, and Selling Costs—5s. per ton sold. 16,000 tons of the commodity were produced during the period. You are required to ascertain :

- (a) The value of the raw materials used.
- (b) The cost of the output for the period.
- (c) The cost of the turnover for the period.
- (d) The net profit for the period.
- (e) The net profit per ton of the commodity.

Society of Incorporated Accountants and Auditors (Final).

13. Prepare a Cost Sheet of any manufacturing business with which you may be familiar, insert *pro forma* entries, and show how the total cost of an article (or group of articles) is arrived at. Explain carefully the source of each entry you make and the method you have adopted of allocating indirect charges.—*Chartered Secretaries (Final)*.

14. Select an article in common use, describe the materials, labour, and expenses entering into its cost of production, and frame a Cost Sheet calculated to present to the manufacturer details of the cost of production.—*Incorporated Accountants (Final)*.

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15. From the undermentioned particulars, prepare a cost sheet of the Northern Brickworks, Limited, indicating cost and profit per 1,000 bricks.

Wages (Clay getting, Machines, Drying, Setting, Burning, Drawing, Sorting, Loading) £7,500.

Coal : 5,000 tons at 15s. per ton.

Royalties at 1s. 6d. per 1,000 bricks made.

Depreciation of Plant and Machinery, 10 per cent. (Capital outlay of £15,000).

Removal of Overburden at 1s. per 1,000 bricks.

Works Oncost, 10 per cent. of Wages and Coal.

Office Oncost, 2½ per cent. of Wages and Coal.

Bricks made, 10,152,284 (allow for waste 1½ per cent. of output).

Bricks sold, 8,000,000 at 40s. per 1,000.

Stock of Bricks January 1st, 2,000,000 at 30s. per 1,000.

Stock of Bricks December 31st, 4,000,000 at 30s. per 1,000.

Incorporated Accountants (Final).

16. Below is enumerated expenditure in the manufacture of X :—

	Three months ended	
	30/9/33.	31/12/33.
Raw Materials	2,550	2,800
Fuel	670	690
Electric Power	130	134
Process and General Wages	6,030	6,350
Repairs	208	240
Haulage	92	106
Light and Water	40	40
Rent	200	200
Rates and Insurance	30	30
Salaries and General Expenses	700	700
Administration	500	500
Depreciation	250	250
	<u>£11,400</u>	<u>£12,040</u>
Make (tons)	15,200	17,200

Prepare a cost sheet showing the comparative (itemised and total) cost per ton for each of the two periods.—*Incorporated Accountants (Final).*

17. B. Jones manufactures Vacuum Cleaners. He makes three types, namely, the "Midget," the "Standard" and the "De Luxe." His accounts to December 31st, 1934, his first year of production, were as under :—

	£		£
To Materials Consumed	6,500	By Sales	16,380
„ Direct Labour	3,150	„ Stock of Finished	
„ Factory Expenses	2,700	Machines	385
„ Gross Profit, carried		„ Work in Progress :—	
down	5,180	Materials	£405
		Labour	150
		Factory Oncost	150
			<u>765</u>
	<u>£17,530</u>		<u>£17,530</u>

	£		£
To Office Expenses . . .	1,400	By Gross Profit, brought	
„ Selling Expenses . . .	700	down	5,180
„ Net Profit	3,080		
	<u>£5,180</u>		<u>£5,180</u>

He has kept rough Cost Accounts charging out Materials and Labour at actual cost, "Factory Oncost" at 100 per cent. on Labour, and "Office and Selling Oncost" at 15 per cent. on Factory Cost. Finished Machines and Work in progress are valued at Factory Cost.

The following figures are taken from his Cost Accounts :—

	Midget. £ s. d.	Standard. £ s. d.	De Luxe. £ s. d.
Average Cost of Materials per finished Cleaner	1 5 0	2 5 0	3 10 0
Average Cost of Labour per finished Cleaner	15 0	1 0 0	1 5 0
Number of finished Cleaners manufactured	1,550	1,230	320
Vacuum Cleaners sold	1,500	1,200	300
Sale Price per Cleaner	4 4 0	6 6 0	8 8 0

Prepare :—

- Statement showing, on the basis of Jones's Cost Accounts, (1) the total profit, and (2) the profit per Vacuum Cleaner sold.
- Reconciliation of the Profit shown by these Cost Accounts with the Profit and Loss Account balance of £3,080.—*Incorporated Accountants (Final)*.

18. Prepare a final cost summary for a manufactured product, showing in parallel columns the standard cost per sales unit based on three varying volumes of output reflecting higher and lower cost efficiencies. Overhead expenses should be shown separately in such a way that your figures reflect the effect of different outputs.

Institute of Cost and Works Accountants (Final).

CHAPTER XX

UNIFORM COSTING

1. UNIFORM OR STANDARDISED COSTING SYSTEMS

The Development of Uniform Costing.

(i) Amalgamations and close working arrangements between groups of manufacturers in particular industries, and organisation for rationalisation, have necessitated, to a certain extent, the establishment of some degree of uniform costing by industries. In the case of particular manufacturers who control a number of factories situated in different districts, co-ordinated uniform costing has been introduced in order that the costs at each factory may be properly comparable. Uniformity of application of principles ; of allocation and recovery of overhead expenses ; and of determining cost and selling prices are found to be advantageous for comparing efficiencies and as a means of controlling unit costs.

(ii) Again, in the case of electricity supply undertakings, owing to the rules laid down in the Second Schedule of the *Electricity (Supply) Act, 1926*, for ascertaining the cost of production of electricity, at which cost the Board of Electricity Commissioners purchase the current produced, most undertakings operating under the scheme have arranged their costing on similar lines. (See Ch. XXIII.)

(iii) In a different class may be considered those uniform systems which have been devised and introduced into particular industries by various federations or associations of manufacturers, as, for example, in such industries as paper-bag making, printing, tin box making, etc. One of the purposes of these particular schemes is to render competition less destructive, by ensuring that all the members know what is included in cost, and how to arrive at it, but this does not include any provision for disclosure of members' costs. Other purposes of this type of uniform costing are connected with a standardised method of collecting figures in order to fix selling prices on a basis acceptable to those engaged in the industry.

Various associations and federations have issued a uniform costing system for their respective industries. The adoption by

individual firms is voluntary and many of them do not put the approved uniform system into operation, although in some cases some of its features may be introduced into their existing system.

Of the systems organised by trade associations, that of the British Master Printers' Federation was the first serious attempt at devising a uniform system of costing, and is probably the most complete. An official outline of the system is given in this chapter.

Requirements for Uniform Costing.—Apart from any decision whether single, process, or job costing is desirable, the following details require to be determined :

(1) The bases for the apportionment and allocation of overhead.

(2) The departments, sections, or production centres to be used for analysis and comparison of costs.

(3) What items shall be regarded as factory as distinct from administration expense.

(4) How expenses of administration, distribution, and selling shall be applied to prime cost, *i.e.* the basis of recovery rates.

(5) How expenses in connection with the buying, storing, handling, and issuing of stores materials shall be treated.

(6) What rates of depreciation shall be applied to plant and machines.

(7) Whether interest on capital is to be included, and, if so, how, and on what basis.

(8) What rent charge is to be made for buildings if freehold or leasehold.

(9) How service departmental costs shall be arrived at.

(10) The demarcation between direct and indirect wages.

(11) In the case of time- and piece-work, whether the time or wage basis, or both, shall be used for determining expense rates.

(12) What organisation can be set up to prepare comparative statistics for the use of those adopting the uniform system. Privacy of individual data and confidence in the co-ordinating office are essential factors.

The Purposes and Value of Uniform Costing.—In a group of amalgamated manufacturers, or in the case of a firm controlling a number of factories, actual detailed costs can be compared, standard costs may be set up, and controls by

Effect of the Overhead Rates used.—The application of overhead expenses by a percentage of the departmental cost has the effect of increasing the cost of production when pressure of work increases the departmental wages, and, correspondingly, decreases the cost of production when lack of work reduces the departmental wages bill. This applies to the normal fluctuations, and not to abnormal conditions, which would necessitate a recasting of the budget.

The departmental totals of value of production from Form 4 can be compared with the cost of production, and the difference shown as a surplus, or a deficit, as the case may be.

These two forms provide the management with information of great value as to whether the capacity of the factory to produce is being maintained.

The Federation publish a text-book containing full details of the system, and illustrations of a great variety of forms for use in connection with the system, but these are too numerous to reproduce in this book.

The Departments into which costs are divided are dependent upon the size and nature of the business. For a large firm they would be as follows: composing, foundry, machining, ruling, binding, lithography, materials. The composing may be further divided into hand composing, monotype, and linotype.

The Basis of Allocation Used.

Rent, Rates, Heat, Light, and Water are in most cases apportioned to departments on the basis of square feet of area.

Fire Insurance.—That on buildings by area; on plant and contents according to value in each department; on standing formes and work on litho stones and plates, separate accounts with a view to recovery by a definite charge.

Insurance for consequential loss (profits and standing charges) is treated as general overhead.

Workmen's Compensation and employers' liability payments, on the basis of wages paid in each department.

Interest on Capital.—A charge of at least 5 per cent. is debited to each department on the value of the plant and stock therein. Interest on the balance of the capital in the business is included in general overhead.

Depreciation.—Usually, type 10 per cent., plant $7\frac{1}{2}$ per cent. off the diminishing value. Replacement values of pre-war plant should be used.

Loss in melt of metal used by monotype and linotype plant

depends on the frequency of melting; 2 per cent. per melt (of which there are two) is usually taken, and by multiplying 4 per cent. by the total value of metal melted, the depreciation per annum is arrived at.

Holiday Payments.—The cost of fixed holidays, and annual

FIG. 120.

PRINTER'S COST SHEET

Customer's Name and Address : F. Smith & Co., High Street, London. Work Ticket No. 391.
Details : 20,000 Annual Reports as per Work Ticket, La. Post 4to fly,
printed in black and red.

Composing Room.*						Materials.							
19...	State Hand or Mono.	Hrs.	£	s.	d.	19...			£	s.	d.		
July 30	W. Jones, Hand Comp.	3½				Aug. 2	10,080 Sheets Cr. Ld. L. Post		9	10	0		
" 31	W. Jones, Hand Comp.	6½					Ink No. 8			5	0		
Aug. 3	W. Jones, Author's corrections	2					" No. 4			2	6		
							20 M. Envelopes	11/-	11	0	0		
	At 5s. 6d.	12	£3	6	0		Add handling charges	20%	4	3	6		
									£25	1	0		
Machine Room.						Outwork.							
19...	Man.	Machine.	Time.	Rate	£	s.	d.	19...			£	s.	d.
Aug. 2	15	E 3	8					Aug. 7	Addressing Envelopes		2	0	0
" 3	"	"	8						Add charges	12½%	1	12	6
" 4	"	"	8										
" 5	"	"	6										
			30	4/6	£6	15	0				£3	12	6
Binding Room.						Summary.							
19...		Hrs.	At.	£	s.	d.	19...				£	s.	d.
Aug. 5.	Folding	10	2/-	1	0	0	Composing				3	6	0
	Cutting	—	—		4	6	Machining				6	15	0
	Piecework	—	—		16	0	Binding				3	14	6
	% on 16s.			1	14	0	Materials				25	1	0
							Sundries				3	12	6
											£42	9	0

* Where mono- or linotype composing is used a separate section may be introduced, as this will be charged at a different hourly rate from hand composing.

The form is kept in the office and entered up daily from the daily dockets, and on completion is filed with the Work Ticket.

The hourly rates are used only for the purpose of an example.

holidays given to employees, is included in the annual expense budget for each department; thus the cost is evenly distributed over the year.

General Expenses on Materials.—Handling charges, *e.g.* buying, receiving, storing, issuing, delivering, are added to

the cost of materials; also a proportion for management and office expenses.

The remaining general expenses, *i.e.* travellers' salaries, commission, expenses, spoilage, and the sundry expenses, are also applied as a percentage on materials. In the case of customers' own paper, an addition is made for handling and storage cost.

Cost Sheets.—A convenient form of cost sheet is shown in Fig. 120.

EXAMINATION QUESTIONS

1. Outline a system of Costing suited to the Printing Trade.

How would you recommend the following expenses should be allocated? Power, Depreciation, Fire Insurance, Workmen's Compensation, Repairs and Renewals of Machinery and Plant, General Expenses.—*London Chamber of Commerce.*

2. Printing machines are made to print appropriate sizes of paper and usually cost more as the sizes increase. To meet the requirements of customers it frequently happens that a small sheet must be printed on a large machine. What procedure should be adopted when assembling the costs of the job?—*Institute of Cost and Works Accountants (Final).*

3. What information from a uniform Cost System would you suggest as particularly useful to manufacturers in the same line of business?—*Institute of Cost and Works Accountants (Final).*

4. What steps would you take to establish a system of uniform costing for fixing price standards in an industry controlled by a Combine?—*Institute of Cost and Works Accountants (Final).*

5. What items of general expense would you expect to show most change per centum as a result of a Combine? Indicate the direction of, and reasons for, these changes.—*Institute of Cost and Works Accountants (Inter.).*

6. Your firm propose making an amalgamation with another, and wish you, as Cost Accountant, to investigate and report. What especial features would you take into consideration for that report?—*Institute of Cost and Works Accountants (Final).*

7. The studio and design department of a printing business prepares ideas which are sometimes accepted by clients, but a large proportion of the work so produced is abandoned as unsuitable. How do you consider the cost of such a service should be recovered? Give your reasons.—*Institute of Cost and Works Accountants (Inter.).*

8. A proposal is being considered to amalgamate two factories at an estimated cost of £50,000. The savings expected to result therefrom are estimated at £20,000 per annum. State broadly the details of the savings, aggregating £20,000, that you would assume to follow on the amalgamation, and how you, as Cost Accountant, could contribute to the discussion of the proposal.—*Institute of Cost and Works Accountants (Final).*

9. How would you propose to deal with the following items in your costs: (a) Warehousing expenses incurred in a printing business? (Part of Question).—*Royal Society of Arts (Advanced).*

10. State concisely your opinion as to the possibility of standardising costing systems in particular industries. Give reasons showing whether it is or is not desirable to attempt this task.—*Society of Incorporated Accountants and Auditors (Final).*

11. From the following data prepare six prices per thousand for printing an art wrapper, viz. :—

(a) First orders of 50,000; 100,000 and 250,000. (b) Repeat orders for 50,000; 100,000 and 250,000. Cost of sketch and lithographic work, £40. Making machines ready for printing, £20. All other work (per thousand), £2. Add for general overhead and profit, 25 per cent.—*Institute of Cost and Works Accountants (Final)*.

12. What advantages would you expect to accrue from the institution of a uniform system of costing throughout an industry.—*London Chamber of Commerce*.

13. State as fully as possible what you consider are the advantages and disadvantages of uniform costing to :—

- (a) an individual firm;
- (b) an industry;
- (c) the public.

Institute of Cost and Works Accountants (Final).

14. As Cost Consultant to a trade organisation, you are requested to investigate the cost systems of various concerns with a view to the introduction of a uniform cost system. Describe the general lines upon which you would proceed, and indicate the principal preliminary difficulties to be overcome.—*Institute of Cost and Works Accountants (Final)*.

15. A company has acquired a new undertaking. Because the accounting systems of the parent and subsidiary companies differ, results are not comparable. Uniformity of methods would render void for either company comparisons with previous periods. Suggest a compromise.—*Institute of Cost and Works Accountants (Final)*.

CHAPTER XXI

IRON FOUNDRY COSTS

The Costs in an Iron Foundry are required as follows :

The Cost of the Pattern Shop.

The Melting Department or Cupola Cost.

The Moulding Shop Cost.

The Fettling and Cleaning Department Costs.

The Smiths' Shop Costs in the Foundry.

The procedure described in this chapter is that for a General Foundry, making all sorts of iron castings, and not a highly specialised one.

Where the work is constant and uniform in a foundry, that is, where a more or less single product is made, a method worked out on similar lines to the machine rate is often employed for job-costing and estimating. Each man and boy is regarded as a centre of production. The whole of the expenses is then carefully analysed, and charged on varying bases, to the centre of production, the total to each centre being divided by the normal hours worked. This gives a working expense rate to each operator in the foundry, and is an alternative to the percentage method here advocated.

Statistical Records Required.—(1) A daily charge sheet for the cupola (Fig. 121) should be prepared giving details of :

(a) The various grades of iron used in pig.

(b) Coke, limestone, etc.

(c) The number of charges.

(d) The quantity of new scrap put in, as against own scrap produced previously.

Tests can be taken over a short period of a week, or more, to ascertain the loss by :

- (a) Keeping a record of all iron going into the cupola.
- (b) After ladles are lined, weighing them.
- (c) Filling the ladles from the cupola, skimming them and re-weighing.

Fig. 121.

DAILY CUPOLA RECORD

Date :

Metal charged :					Tons.	Cwt.
Pig Iron		
Bought Scrap		
Own Scrap		
Total		
Coke consumed		
Limestone consumed		
Castings Produced		
Loss in Melting		
Coke Consumed per Ton of Metal Melted		

The difference between each day's weighing into and out of the cupola will represent, under normal conditions, a fair index to the loss in melting (see Fig. 122). Much depends on the quality of pig and scrap used, but, taking tests in different periods in the year, a percentage is found, which can be used with reasonably accurate results.

The Use of these Records :

(1) The total input less the loss in melting gives the total output.

(2) Total output minus the weight of saleable castings, wasters and sundry tackle represents the runners, risers, heads, and metal over-melted.

(3) The amount of loss in melting is a guide to the quality of the scrap and pig purchased.

(4) The coke consumption per ton of metal melted reflects the quality of the coke purchased.

Alternative Method to find Metal Melted.—Ignore the total output of the cupola, take the total weight of the saleable good castings, the wasters, and the tackle, and apply the percentage loss in melting, say, 6 per cent.

Then for an output of 100 tons the formula would be

$$\frac{100 \times 100}{94} = 106 \text{ tons } 8 \text{ cwt. approximately of metal melted}$$

FIG. 123.

Stock Record Laminar
Stock of Materials at 28 February, 19...

	Goldenale Pig.			Hamatite.			Foundry Quality, No. 2.	White Iron.	
Stock (opening)				20	10	75/-	70	17	6
Involved				50	-	70/-	100	0	0
(Items detailed)				curr. paid					
Carriage & Wag. Hire				50	-	3d.		12	6
Haillage				70	10	75/10	267	10	0
Transferred				-	-		-	-	-
Used				80	10	70/-	220	18	0
Stock (closing)				10	0	75/-	37	12	0

Sections are repeated for each material. Other headings are Silky, Foundry 1, Low Silicon, Hamatite Scrap, C. I. Scrap, Sand, Gaster, Coal, Coal-dust, Core Oil, Core Gum Mixture, Blacking, Straw Ropes, Plumbago, Wood Wool.

Materials—Stocktaking of Materials on the “Used” Basis.—Stocktaking, *physically*, is of prime importance in the case of materials used in bulk. All materials on hand on the first of each month, whether under cover or in the open yard, must be recorded, by actual weight if possible, or by actual count.

The method of keeping a stock record of receipts and issues known as the “Book Stock” is not usually satisfactory.

The materials used in each department are :

Melting Department.—Coke, ganister, limestone, bricks, fireclay, oxygen, feeding irons, etc.

Moulding Shop.—Sand, cowhair, manure, blacking, plumbago, chaplets, sprigs, coal dust, small tools.

Core Shop.—Sand, coke, coal, straw ropes, wood wool, core gum, resin, core oil, wax wire, iron wire, small tools, core irons.

Fettling Shop.—All tools for chipping; materials for cleaning, such as brushes, file card, sand-blast material, goggles, filling compounds, etc.

WAGES ANALYSIS

1. **Direct Wages** are analysed under departmental headings as follows :

Melting Department—Cupola.—Cupola tenters, labourers handling iron and fuel, stocking and weighing-in.

Moulding Shop.—Wages of moulders and helpers in dry sand, green sand, and loam moulding; machine moulding; bench or stump moulding.

Core Shop.—Wages of core-makers and helpers, including core-turning machine workers.

Fettling and Cleaning Department.—Wages of fettlers and blasters, chippers, tumbling and inspection.

Smiths' Shop in Foundry.—Smiths and strikers.

Machine Shop.—In foundries dealing with small castings there may be a machining shop, but as the costing in this department follows the usual procedure in an engineering works, which has already been dealt with in other chapters, and is not essential to the understanding of foundry costing, it is thought unnecessary to deal with it here.

Repairs and Maintenance.—The labour is charged up against Standing Order Numbers, suitably coded, for such expenses as :

Buildings.	Core-turning machines.
Cranes.	Cupola stoves.
Loam mills.	Electrical equipment.
Compressors.	Blowers,
Moulding machines.	etc.

The materials issued from stores will be similarly charged out against requisitions on which standing Order Numbers are shown. In addition, there are purchases generally requisitioned for immediate use, *e.g.*

Wheels for crane tracks.	Timber.
Ropes for cranes.	Bricks.
Iron for tools.	Cement,
Electrical equipment parts.	etc.

These latter will be analysed in the Purchases Book, suitably ruled with columns in addition to those for various stock materials, and other purchases.

A form of schedule for monthly repairs is shown in Fig. 125.

Overhauls, Renewals and Heavy Repairs to Plant.—A provision, based on previous experience, is made to ensure a fairly level cost per ton, which will cover any such expense. A Suspense Account may be opened, and to this are credited the amounts charged to each department monthly. When overhauls of a heavy nature occur, the cost is debited to this Suspense Account.

Depreciation.—A rate to cover depreciation in each department should be applied to each part of the equipment, and a monthly charge made against current costs.

Moulding Equipment (Loose).—This expense consists of such items as flasks, boxes, iron patterns, etc., which are in general use. Watch has to be kept on this expenditure, as this equipment is often broken and thrown into the cupola, and, unless checked, misleading figures arise. Repairs and renewals of these are chargeable to current cost.

New boxes, etc., which have to be made, should be charged as a rate per ton of castings made. The rate is revised periodically, to ensure recovering the cost of this equipment, less the residual, or scrap value, as may be decided.

A Loose Plant Account is used to control the making of box parts, core bars, and special tackle. It is debited with the total making cost of these items, and credited with the amounts

which have been debited to the summary foundry cost, at a rate per ton of castings made, as described in the preceding paragraph. It is thus equivalent to a depreciation account.

Overhead Charges Account.—This shows the collection and distribution of overheads. A proportion of each item of expense is apportioned on an appropriate basis to each shop for power, lighting, insurance, rates, depreciation, laboratory, compensation, medical supplies, water, sundry stores, etc. Where possible, the charge is direct to the shop concerned. The total overhead for each shop is allocated to the various orders dealt with, usually *pro rata* to weight or hours.

General Administration Expense is shown separately on the monthly summary. It is applied to individual jobs on the basis of the *total* direct labour by the percentage shown in the monthly summary. A Control Account is used, which shows the total debited to the Foundry, and the amount recovered on jobs.

Pattern Shop.—It is usual to keep a separate trading account for the Pattern Shop.

Practically the whole of the cost of patterns and repairs of old patterns is a "direct" charge against the Foundry, except for patterns for sale or for contracts worked for other firms, when pattern costs for these are charged to the castings orders, or pattern orders. The cost consists of wages, materials, and shop overhead, apportioned to this department, plus the proper proportion of management charges.

Monthly Foundry Summary Cost.—A form actually used is shown in Fig. 126. At the head of the form is entered the weight of the various classes of output, and this is followed by the total cost and cost per ton for each department. It forms the basis for costing jobs.

FIG. 126.

FOUNDRY SUMMARY COST
Month of

				Tons.	Cwts.	Qrs.	Lbs.	Per-centage.
Saleable Castings				315	10	—	22	57
Box Parts				11	1	1	18	2
Iron Patterns				—	—	—	—	—
Tons.		Cwts.	Total Saleable	326	11	2	12	59
Saleable Tons Divisor.	326	12	Waster Castings	38	14	3	20	7
			Tackle and Plant	99	12	2	21	18
			Runners, Risers, Heads, etc., etc.	55	7	—	6	10
			Total Cast	520	6	1	3	94%

Month of

			Amount.	Total.	Cost per Ton.	Total Cost per Ton.
L. Metal.	Tons.	Cwts.	Rate.	£ s. d.	£ s. d.	s. d.
Foundry Pig Iron .	281	16	58/-	1107 4 5		
Hemetite Pig Iron .	23	10	75/-	89 2 6		
" Scrap .	34	7½	67/-	113 2 3		
Cold Blast Iron .	-	-	-	- - -		
Steel Scrap .	2	10	45/-	5 12 6		
Cast Scrap (new) } (own) }	111	7½	42/6	236 12 11		
Total = 100% .	553	10¼	56/1-2d	1552 14 7		
Credit for Wasters, Runners, Risers, and Tackle .	193	14-2-19	40/-	337 9 4	1165 5 2	71 4-29
2. Cupola Cost (Cost per Ton of Iron Melted).						
Wages .	2	d. 9-96	78 6 8			
Ganister, 13 tons at 22s. 6d. .		6-34	14 12 6			9-56 10-75
Limestone, 16 tons at 7s. 2d. .		2-49	5 14 8			4-21
Coke (cwis. per ton melted iron, 2 C. 10 lb.), 58 tons, 2 cwt. at 32s. .	3	4-31	92 18 2			5 8-31
Sundry Stores, etc. .		3-79	8 15 0			6-43
Laboratory .		1-52	3 10 0			2-57
Repairs, etc., as per Schedule .		8-42	19 8 4			1 2-27
Suspense Account .		5-26	12 0 0			8-52
Depreciation .	1	5-76	39 11 9			2 5-09
Proportion of Power, Light, Rates, etc. .	9	11-19		274 15 1		16 10-01
3. Moulding Shop.						
Wages : Moulding in Dry Sand .			150 2 10			9 2-33
" " in Green Sand .			310 1 4			18 11-55
" " in Loam Sand .			589 14 5			35 6-74
" " by Machines .			38 4 5			2 4-09
Indirect Labour, as per Schedule .			401 1 3			24 6-72
Repairs, etc., as per Schedule .			249 4 4			15 3-14
Suspense Account .			123 0 0			7 10-79
Depreciation .						8 10-62
Proportion of Power, Light, Bates, etc. .			145 1 11			
Materials used :						

	Amount.			Total.			Cost per Ton.		Total Cost per Ton.	
	£	s.	d.	£	s.	d.	s.	d.	s.	d.
Brought Forward										
5. <i>Fettling and Cleaning Shop.</i>										
Wages	114	2	11				6	11-88		
Indirect Labour, as per Schedule	22	1	9				1	4-23		
Repairs, etc., as per Schedule	8	3	3					6-00		
Suspense Account }	3	0	0					2-20		
Depreciation }	9	12	8					7-08		
Proportion of Power, Light, Rates, etc.	2	18	6					2-15		
Sundry Materials and Stores										
Percentage of Overhead Ex- pense to Direct Wages 20-78%				159	19	1			9	9-54
Total Percentage 46-15%										
6. <i>Smiths' Shop.</i>										
Direct Wages	19	19	9				1	2-69		
Coke	4	10	0					3-31		
Sundry Stores	1	0	0					0-73		
Iron and Steel (Direct Materials)	5	2	9					3-78		
Repairs, etc., as per Schedule	1	12	6					1-19		
Suspense Account }	1	0	0					0-73		
Depreciation }	6	10	0					4-78		
Proportion of Power, Light, Rates, etc.				39	15	0			2	5-21
Percentage of Overhead Ex- pense to Direct Wages 73-16%										
Total Percentage 98-53%										
7. <i>General Expense and Establishment Charges.</i>										
Salaries of Manager, Clerks, and Officials	203	14	9				12	5-71		
Salaries of Salesmen and Expenses	59	7	7				3	7-63		
General Charges (i.e. Directors, Auditors, Law Charges, etc.)	76	0	0				4	7-85		
Telegrams, Telephones, Stationery, etc.	24	0	0				1	5-64		
Percentage of General Expense to whole of Direct Wages for Foundry 25-37%				363	2	4			22	2-83
8. <i>Total Foundry Cost for Unmachined Cast- ings</i>										
Machine Shop.										
Wages: Machining Direct to Customer's Orders										
" Fitting Direct to Customer's Orders										
" On Repair Work for Foundry (to Repairs Schedule)										
Direct Materials to Customer's Orders										
Establishment Charges and Overhead Expense to Customer's Orders										
Establishment Charges and Overhead Expense to Repair Work (to Repairs Schedule)										
Total Foundry Cost £				£4968	19	2			304	3-41

<i>Stock and Production Statement.</i>	Tons.	Cwts.	Qrs.	Lbs.	Rate.	£	s.	d.
Stock of Castings at beginning of Month	84	2	1	7	300/0 00	1261	14	8
Cost of Good Castings in current Month	326	11	2	12	304/3-41	4968	19	2
Total	410	13	3	19	303/5-05	6230	13	10
Less Castings in Stock at end of Month	68	9	1	4	300/0-00	1026	10	0
Cost of Castings delivered during Month	342	4	2	15	304/1-28	£5203	14	10

FIG. 127.

Name of Customer or O/No.	Description.		Weight Cast.			Weight with Cupola Waste Added.	Hematite Pig.			No. 4
							Weight.	Rate	£ s. d.	Weight.
	Couplings, Frames	100% Hematite	4 13	1	7 1					
			4 13	1	7 1	4 18	2 10	4 18	2 10	17 16 4
	Couplings	33% Hematite	3	2	3					
	Pistons	57% Foundry	4	0	16					
	Spur Wheels, etc.	10% Steel	2	6	1 10 1					
	Surge Wheels, Fly-wheels	"	6 17	3	19					
	Surge Wheels, Rope Pulley	"	1 17	5	8 1					
	Blocks	"	4	0	7					
	Pulley	"			1 13					
	Crushers	"	2 14	2	8					
	Haulages	"	4 18	0	18					
	Sliding Collar	"	5	0	0					
	Beds	"	7 10	2	0					
	Cylinder Covers	"	3	1						
			27	3	0 20	28 13	3 10	9 11	1 3	34 11 4
	Firebars	{ 20% Steel 80% Foundry }	5 14	2	3 1					
			5 14	2	3 1	6 1	0 0			
	Liners	{ 40% Hematite 20% Steel 40% Foundry }	2 14	0	20 1					
			2 14	0	20 1	2 17	1 0	1 2	2 17	4 2 9
	Hammer Block	{ 40% Hematite 25% Steel 35% Foundry }	1 4	0	0	1 5	1 9	10	0 14	1 16 7
	Cylinders and Rams	{ 26% Forge 4 10% Steel 64% Foundry }	11 19	1	0	12 12	3 4			2 6
	Tackle for Loam Moulding	{ 25% Hematite 75% Foundry }	46	0	0 0	49	1 2 0	2 5	3 1	8 16 2
	Cradles	{ 25% Hematite 25% Steel 50% Forge }	3 4	0	0	3 7	2 14	16	2 17	3 1 1 1 13
	Pipes	{ 100% All Foundry }	278	17	0 16 1	294	12 1 23			
			341	13	1 16 1					
	Cylinders and Rams	{ 10% Steel 10% Hematite 25% Forge 55% Foundry }	24 18	1	7					
			24 18	1	7	26	6 2 0	2 12	0 0	9 12 0 1 6 1
	Weighted Plates	{ 20% Hematite 80% Foundry }	1 8	0	2 1					
			1 8	0	2 1	1 9	3 2	6 0		1 1 9
	Crushers	25% Hematite	12 16	5	10					
	Blocks	5% Steel	6	1	0					
	Haulages	75% Foundry	11 16	0	2					
			25 11	0	12	27	0 0 0	5 8	0 0	19 3 0
			433	16	0 22 1	458	6 2 16	27 14	2 8	103 1 0 11

DISTRIBUTION TO ORDERS

Forge.			Steel Scrap.			Foundry Quality Pig Iron and Scrap Metal.						Total Amount.	Rate per Ton.
Rate.	£ s. d.	Weight.	Rate.	£ s. d.	Weight.	Rate.	£ s. d.					£ s. d.	£ s. d.
												17 16 4	
												17 16 4	76 4-42
												10 8	
												12 6	
												7 0 4	
												20 17 6	
												5 14 7	
												12 4	
												1 1	
												8 5 2	
												14 17 2	
												15 1	
												22 15 6	
												2 4	
		2 17 1 16		6 2 0	16 5 0 19		41 10 11					82 4 3	60 5 63
												14 18 11	
		1 4 0 0		2 11 1	4 17 0 0		12 7 10					14 18 11	52 2-33
												8 5 7	
		11 1 22		1 4 4	1 2 3 17		2 18 6					8 5 7	61 1-48
		6 1 7		13 6	8 5 16		1 2 9					3 12 10	60 8 57
		8 14 10	1 5 1 4	2 13 10	8 1 1 7		20 12 2					32 0 10	53 6-63
		16 3 17		1 16 0	43 13 3 10		117 0 1					127 12 3	54 11-35
		4 9 4			16 3 15		2 3 2					9 13 7	60 5 94
		7 0 3		15 0	294 5 1 18		710 3 9					710 18 9	50 11-87
												883 18 3	51 8 89
												63 13 1	
		17 7 9	2 12 2 15	4 19 6	14 10 0 27		33 13 10					65 13 1	52 8-40
												3 16 11	
					1 3 3 2		2 15 2					3 16 11	54 7-07
												36 19 7	
												17 2	
												32 9 4	
		1 7 0 0		2 11 10	20 5 0 0		45 11 3					70 6 1	55 0 28
		30 11 11	11 8 0 2	23 7 1	407 12 1 22		992 19 5					1146 19 5	52 10 55

The item "Suspense Account" is the charge to cover average cost of overhauls and heavy repairs. The percentages show the relation between the direct and indirect cost of each shop.

The Cost of Jobs.—The data collated and shown in the Summary Cost are the basis for costing any particular job, class cost, or tonnage cost, that may be required.

A Cost Account for each job is opened in the Cost Ledger (see Fig. 128), and debited with all actual expenditure in wages and material, together with the proper allocation of works overhead, and administration overhead, as indicated by the various percentages and rates ascertained in the Summary Cost Sheet.

Wages.—The job times and wages are recorded and abstracted in the usual manner.

Materials.—Purchases specially made for specific jobs are debited direct, and stores materials from the abstract compiled from requisition issue slips.

The correct charge for iron used requires careful records of mixtures to avoid an average cost per ton. The procedure is as follows: the Foundry Office supplies a return giving the mixture for all special work, for example:

Cylinder, O/NO. 2932.

20 per cent. hæmatite iron.

3 per cent. steel.

77 per cent. ordinary foundry iron.

When the iron cost for all the special work has been worked out, then the remainder is common to all other castings made.

An Iron Account for distribution to orders, showing the weight, total cost, and cost per ton for each, is illustrated in Fig. 127.

Overhead.—The following bases for distribution to jobs are used:

Cupola Cost.—The total cost of the melting department, as per summary cost, is divided by the total weight of metal poured (Fig. 122). Each job is debited on the basis of saleable weight and wasters with its proportion.

Moulding Shop Cost.—Each job is debited with the actual cost of moulding, and the overhead, at a percentage on direct labour in moulding, as per the Summary Cost. In the case of cored castings, the core-making cost is similarly arrived at.

On the other hand, any subsequent process such as dressing, sandblasting, and annealing are charged at a cost per ton of good castings.

Pattern Shop Charge is distributed on an actual cost basis to every job where pattern-making is involved.

Fettling and Cleaning expense is charged on a tonnage basis determined as a unit cost of good castings dressed, excepting in the few cases where a direct charge can be made. Only castings so dressed bear this charge.

FIG. 129.

COST LEDGER FOUNDRY MANUFACTURING ACCOUNT

Month of :19..

Dr.		Amt.		Total.		Cr.	Tons.		Amt.		Total.	
		£	s. d.	£	s. d.				£	s. d.	£	s. d.
To Opening Stocks of Materials :						By Cost of Manufacture transferred to Trading Account.						
Pig Iron												
Hematite Iron												
Scrap Iron												
Limestone												
Sand												
Coal												
Cupola Coke												
Stove Coke												
Other Materials												
To Purchases during Period :						Closing Stocks :						
Pig Iron												
Hematite Iron												
Scrap Iron												
Limestone												
Sand												
Coal												
Cupola Coke												
Stove Coke												
Other Materials												
Less Closing Stocks as per details in inset						Deducted contra						
To Material Used												
To Wages :												
Cupola												
Manufacture												
Labour												
Repairs												
To Stores Issued (Indirect) :												
Oils, Grease, and Waste												
Materials for Repairs												
Sundry Supplies												
To Charges from other Departments :												
Electricians												
Pattern Shop												
Carpenter's Shop												
Electric Power												
Gas, etc.												
To Depreciation												
To Suspense Account												

Sandblasting and Annealing processes are each costed and a cost per ton determined. Only good castings which have been treated in either or both these processes will be charged with this expense, the charge being a rate per ton.

Smiths' Forgings.—The overhead is applied as a percentage on direct labour, as shown in the Summary Cost.

Administration.—Expense is charged by the percentage rate, as per the Summary Cost, on the *whole* of the direct labour of each job.

Foundry Trading Account shows the total expenditure for the month on wages, materials, and other items as shown in Fig. 129, which is self-explanatory.

EXAMINATION QUESTIONS

1. In the manufacture of a Steel Ingot weighing many tons, the molten steel is poured into an ingot mould. These moulds are themselves very costly, and the length of their useful life is uncertain. Further, the Ingot itself is often found to be faulty. In ascertaining the cost of Steel Ingots, therefore, how would you deal with

(a) Expenditure incurred in producing an imperfect Ingot;

(b) The cost of the Mould?

Association of Certified and Corporate Accountants (Final).

2. Prepare a weekly Cost Sheet suitable for an iron foundry.—*Institute of Cost and Works Accountants (Final).*

3. Describe the costing system of an industry with which you are familiar and illustrate by diagram how the final figures are assembled.—*Institute of Cost and Works Accountants (Inter.).*

4. The following information has been abstracted from the books of a steel foundry, for last month. Assume that you are in charge of the accounts of the company and set out the figures in whatever way you think most appropriate, for the information of the board at their next meeting.

	Beginning of Month.		End of Month.	
	Tons.	Value.	Tons.	Value.
Pig Iron : Stock	100	£800	120	£1,000
Scrap Iron : Stock	50	£275	40	£245
Sundry Materials : Stock	10	£11	8	£10
„ Stores : Oil, Waste, etc.	—	£5	—	£12
Coal	80	£300	40	£115
Purchases for month : Pig Iron		1,450 tons		£ 12,000
„ „ „ Scrap „		490 „		2,940
„ „ „ Sundry Materials		150 „		210
„ „ „ „ Stores				100
Wages : Works				7,840
„ Office				120
Travellers : Salary and Expenses				210
Coal Purchases : Works		630 tons		1,890
„ used in Offices				20

	£
Power and Light : Works	650
Office Lighting	25
Repairs : Works	467
Depreciation : Works	840
Additions to Buildings	45
" " Machinery and Plant	530
Gas, Water, etc. : Works	76
Rent and Rates : Works	725
" " " Offices	25
Sales : Scrap and Sundries	500
" Castings	1,850
	29,600

London Chamber of Commerce.

5. How would you deal with the case of Patterns in your cost accounts?—*Institute of Cost and Works Accountants (Inter.)*.

6. In an Iron Foundry producing medium weight Castings, the piece-work rates of Wages paid for each operation are adopted as the measure of the Oncost in each department. The piece-work rates applicable to a certain Casting are :

	s.	d.
Moulding	15	0
Core-making	3	0
Dressing	2	0

and the Oncost rates are :

Moulding	80%
Core-making	50%
Dressing	33½%

The weight of this Casting when moulded is 1 cwt., but in the dressing operation it loses 4 lbs. of its weight. Its selling price is invoiced "per cwt." and the cost of Selling, Delivery, and General Administration is 2s. 4d. per cwt., calculated on the weight sold. Calculate the selling price of this Casting per cwt., after providing for :

- 7s. per cwt. for melted metal cost.
- Loss in weight above mentioned.
- 10 per cent. profit on total cost.

Ignore scrap value of metal produced by the dressing operation.—*Association of Certified and Corporate Accountants (Final)*.

7. Enumerate the items which would go to make up Oncost in a Foundry, and explain two methods of allocating these charges.—*Society of Incorporated Accountants and Auditors (Inter.)*.

8. Prepare a detailed Cost Sheet, with figures, in relation to any manufactured article with which you are familiar, and explain the basis on which you have arrived at the proportion of Oncost expenses.—*Society of Incorporated Accountants and Auditors (Inter.)*.

9. How would you propose to cost the products of a brass foundry where castings are made that vary considerably as regards weight, intricacy, and mixture of virgin and scrap metals?—*Institute of Cost and Works Accountants (Inter.)*.

10. Assume that it is the policy of a certain brass foundry to make monthly purchases of copper. The market rates have fallen :

	Per ton.
April, 1929	£105
June, 1929	20
May, 1930	75
September, 1930	45

How would you propose to price withdrawals from store for manufacture carried out during the period in question? State on what basis you assume selling prices to be determined.—*Institute of Cost and Works Accountants (Inter.)*.

11. Set out a form of final cost for a product with the manufacture of which you are familiar, and give as much detail as possible.—*Institute of Cost and Works Accountants (Inter.)*.

12. How would you charge out the expenditure incurred in the Pattern Shop?—*Institute of Cost and Works Accountants (Final)*.

13. A certain works contains a Foundry, Power House, Pattern Shop, Tool Room, and three distinct Machining and Erection Shops. You are requested to advise the management upon the distribution of expense. How will you proceed?—*Institute of Cost and Works Accountants (Final)*.

14. The following are some of the main items of overhead expenditure of a foundry :

General labour for firing, carrying, etc. ;
Examiners ;
Supervision ;
Coke for melting metal and drying moulds ;
Crucibles for melting metal ;
Sand for making moulds.

From the nature of the work it is impracticable to record times of the various operations other than those of moulding, core making, and trimming.

In these circumstances on what bases would you propose to recover the overheads in the cost of the castings made?—*Institute of Cost and Works Accountants (Inter.)*.

15. How would you distribute overheads in the case of a foundry producing a variety of large and small castings?—*Institute of Cost and Works Accountants (Inter.)*.

16. An iron foundry makes heavy castings in loam, castings from patterns, and machine-made castings. Describe a system of costing suitable for such work.—*Institute of Cost and Works Accountants (Final)*.

17. Give a list of General Expenses for one of the following industries, showing in columns, without figures, which of them relate to (a) Works Overhead, (b) Distribution and Selling, (c) General Administration :—Iron Foundry ; Motor Works ; Food Factory ; Soap Works ; Printing Works.—*Institute of Cost and Works Accountants (Final)*.

18. In many industries the making of costly patterns or, in other cases, dies, is necessary before production of an article can take place. The effect of this initial expense upon the cost of producing the article depends upon the quantity of articles likely to be required. How would you deal with this factor of cost—

(a) In preparing estimates of the cost of any particular article?

(b) In determining the On-cost expense of the Department making use of the pattern or dies?

Patterns frequently require to be repaired or altered after use. How would you deal with this expense in preparing the required information under (a) and (b)?—*Association of Certified and Corporate Accountants (Final)*.

CHAPTER XXII

OPERATING COSTS

Unit Cost of Services.—Undertakings engaged in rendering services may be divided into two groups :

- (a) Various forms of transport of goods and/or passengers.
- (b) Public utility concerns, supplying a service, such as water, electricity, or gas.

This method of costing is different from that used in connection with production manufacturing, but may apply to some forms of factory services. The difference lies chiefly in the manner of assembling the cost data, and in its allocation to cost units. A brief description of the costing for various kinds of undertakings falling within the above groups will suffice to demonstrate the procedure.

(1) MOTOR TRANSPORT COSTS

The Purpose.—The records are desired to show the total cost of operating each vehicle, and then to apply this cost to particular units. For example, it may be desired to know the cost per mile, per ton, per passenger, or the cost per ton-mile, per passenger-mile, per parcel-mile, etc.

The costs so ascertained are useful for :

- (a) Comparison between the cost of using motor vehicles owned, and that of using other types of transport, either owned or hired.
- (b) Determining what should be charged against departments, or others, using the service.
- (c) Determining at what price the use of a vehicle can be charged, profitably, to anyone hiring a vehicle.
- (d) Comparing the cost of maintaining and running one vehicle with that of another of the same type and capacity.

The Collection of Data.—The following procedure is that followed by a large business, employing a fleet of twenty motor vehicles.

A daily Report Card is supplied for each car, stating in the space provided at the head of the card (see Fig. 130) the Vehicle No., driver's name, date, route, and time of departure.

At the foot are recorded details of :

(a) Petrol, oil, and other supplies provided by the garage.

(b) Time spent on the car for washing, cleaning, and attending to minor adjustments by the mechanics.

(c) The times of signing on and off by the driver and his assistant.

FIG. 130.

DAILY RECORD CARD

Vehicle No. :				Date :19...			
Driver :				Time left Garage :			
Route No. :				Time returned :			
Trip Record.							
Trip No.	From	To	Tons or Packages.		Miles.	Time.	
			Out.	Collected en route.		Out.	In.
1							
2							
3							
4							
5							
6							
etc.							
Totals							
Supplies.		Workers' Time.		Exceptional Delays.			
Petrol :		Driver :		Loading delays :			
Oil :		Assistant :		Traffic delays :			
Grease :		Cleaners :		Accidents :			
etc.		Mechanics :					

Space is provided for the driver, or despatch clerk, to enter details as to the trips made and the number of packages taken, or the weight. From the speedometer readings, the number of miles run on each trip is recorded, and the time out and in for each trip is entered.

Repairs and adjustments required may be noted by the driver on the back of the card. The particulars of the repairs, etc., are recorded by the garage mechanics on repair tickets, or on the back of the card, and the office costs the work.

The cards are exchanged daily, the completed ones being sent to the Cost Office, where the data are tabulated on analysis sheets; a separate sheet is kept for each car. At the end of the month, the totals of the analysis sheets are transferred to a Monthly Cost Summary for each car.

The Cost Summary.—The Cost Summary for each car will contain the following analysis of expense (Fig. 131), and the cost and performance statement (Fig. 132).

FIG. 131.

MONTHLY CHARGES

Car No. 19.

Month ended February, 19...

A. Operating Charges.				B. Maintenance Charges.			
	£	s.	d.		£	s.	d.
Petrol				Tyres			
Oil				Repairs			
Grease				Overhaul			
etc.				Spare Car			
Driver				Garage Charge			
Assistant				etc.			
Mechanics							
Total	52	12	5	Total	6	15	3

C. Fixed Charges.						Proportion for Month.		
						£	s.	d.
Insurance at £..... per year								
Interest at%								
Depreciation at%								
Tax, licence at £.....								
Other items at £.....								
Total						8	12	4

Notes on Transport Costs.—The costs are divided, as shown in Fig. 131, into three sections, namely, Operating Charges, Maintenance Charges, and Fixed Charges.

Operating and Running Costs.—These vary from day to day, and are incurred by the actual operation of the vehicle; expenses which would not be incurred if the vehicle were placed in storage come under the general head of operating expenses, *e.g.* petrol, oil, wages, etc.

Maintenance Charges.—These include wear on tyres, repairs and overhauls, painting, hire of spare vehicles when cars are under repair, garage rental, etc.

Fixed Charges.—These are incurred whether a car is operating or not. They include insurance, depreciation, interest, and tax.

The Ton-Mile.—Two understandings of the unit ton-mile are in use at the present time. These are known as the “abso-

FIG. 132.

MOTOR TRANSPORT COSTS

Monthly Cost Sheet

No. of Car : 19.

Month of February, 19...

Capacity in lbs. :

Chassis No. :

1. Total Capital cost, complete	£1123-95
<u>Performance Record.</u>	
2. Days operated	26
3. Days idle	4
4. Days maintained (Item 2 ÷ Item 3)	30
5. Total hours operated :	232
6. Total miles covered	803
7. Total trips made	28
8. Total tons or packages or stops or passengers	2792
<u>Performance Averages.</u>	
9. Average miles per day maintained (Item 6 ÷ Item 4)	26-76
10. Average miles per day operated (Item 6 ÷ Item 2)	30-88
11. Average miles per trip (Item 6 ÷ Item 7)	28-67
12. Average tons, stops, or packages per trip (Item 8 ÷ Item 7)	99-7
13. Average commercial ton-miles, package-miles, or stop-miles per trip $\frac{\text{Item 11} \times \text{Item 12}}{2}$	1429-20
<u>Costs for the Month.</u>	
14. Total expenses for month (Sum of Items A, B and C in fig. 131)	£68
15. Cost per day operated (Item 14 ÷ Item 2)	£2-61
16. Cost per day maintained (Item 14 ÷ Item 4)	£2-27
17. Cost per mile operated (Item 14 ÷ Item 6)	1s. 8-3d.
18. Total commercial ton-miles, package-miles, or stop-miles (Item 7 × Item 13)	40,017-6
19. Cost per commercial ton-mile, package-mile, or stop-mile (Item 14 ÷ Item 18)	0-46d.

Note.—For passenger vehicles substitute “passengers” for “tons,” etc.

lute ” ton-mile and the “commercial” ton-mile. The absolute ton-mile may be defined as the carrying of a mass of 1 ton over a distance of 1 mile. The absolute ton-mile takes into consideration the number of tons hauled, and the distances over which all, or portions of the load, were carried. For instance, if a vehicle started from some certain point with a load of 5 tons and travelled 2 miles, it would have accomplished $5 \times 2 = 10$ absolute ton-miles of work. If, at the 2-mile point, the vehicle had delivered 1 ton, leaving 4 tons of load, which it delivered 3 miles farther along on the route, the absolute ton-mileage would have

where cars are used for delivering and collecting at points during a trip.

Recovery of Transport Department Costs may be made by charging to departments or orders on such bases as (a) a calculated rate per hour per vehicle, (b) a rate per vehicle mile, (c) use of standard load rates. The standard load is the maximum load for articles of each department having regard to bulk and weight.

Motor Transport Cost Ledger Accounts.—The abbreviated specimen cost accounts and summaries, Figs. 133 to 139, illustrate the procedure for recording the detailed costs. Fig. 140 is a specimen Job Repair Cost Sheet. These accounts and summaries are self-explanatory.

FIG. 133.

QUARTERLY COST SURVEY

(N.B.—Quarterly totals for group posted to Group Cost Survey.)

Class B.

Vehicle.	Repairs.			Running Charges.			Standing.			Total.			Mileage.
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	
B26	138	4	6	146	4	7	51	4	6	335	13	7	6,167
B27	34	4	11	253	2	9	51	4	6	338	12	2	7,943
B28	100	18	9	137	3	1	51	4	6	289	6	4	4,841
	<u>£1315</u>	<u>9</u>	<u>0</u>	<u>£2250</u>	<u>6</u>	<u>0</u>	<u>£1100</u>	<u>0</u>	<u>9</u>	<u>£4665</u>	<u>15</u>	<u>9</u>	<u>90,419</u>

TRADING ACCOUNT													
To Charges for Quarter				£	s.	d.	By Balance brought forward				£	s.	d.
„ Balance carried forward				4665	15	9	„ 90,419 miles at 1s.				165	0	0
				20	3	3					4520	19	0
				<u>£4685</u>	<u>19</u>	<u>0</u>					<u>£4685</u>	<u>19</u>	<u>0</u>

(2) COSTS OF RAILWAYS AND TRAMWAYS

The expenses are analysed under such headings as :

Power Supply ; locomotives, fuel, oil, repairs.

Maintenance :

(a) Permanent way, its upkeep and renewals ;

(b) Buildings, e.g. offices, sheds, stations, repairs shop expense, stores, etc. ;

(c) Rolling Stock, repairs to carriages or cars, axles and wheels, motors and controllers, lighting equipment.

If a scheduled classification is drawn up, suitable Standing Order Nos. may be used. The Wages Analysis Sheets can be ruled to correspond with those for other expenses.

The statistics which are prepared show the following data

RUNNING COST LEDGER ACCOUNT

Vehicle No. 03.
Class A.

Date.	Miles.	Gallons.	M.p.g.	Petrol.		Tyres and Tubes.		Lubricants.		Driver's Wages.		Service Overheads.	Miscellaneous.	Total.		
				£	d.	£	d.	£	d.	£	d.			£	s.	d.
19... April 2	140	14	10.0	11	0	4	11	0		2	10	0		2	14	0
5	160	16	10.0	10	0					3	0	0		3	10	0
9	150	15	10.0	15	0			2	0	2	15	1		2	16	1
12 13 16 17																
1276 1277 1278																

Fig. 134.

STANDING CHARGES COST LEDGER ACCOUNT

Vehicle No. 03.
Class A.

Date.	Ref.	Capital Value.	Depreciation 5% per Qr.		Interest 11% per Qr.		Licence.		Insurance.		Garage.		Miscellaneous.		Total.		
			£	d.	£	d.	£	d.	£	d.	£	d.	£	d.	£	s.	d.
19... Jan. 16 Jan. 17 Mar. 31	L.11 L.16 D.1	500	25	0	0	15	0	20	0	11	0	0			20	0	0
															11	0	0
															31	16	0

Fig. 135.

Note.—Accounts as above are kept for each vehicle.

Vehicle 224.
Class D.

REPAIR COST LEDGER ACCOUNT

Depot.	Date.	Works Order.	Hours.		Days at Works.	Wages.		Overheads.		Materials.		Depot Mechanic's Wages.		Break-down Service.		Sub-Total.		Credit Recovered.		A/c. No.	Total.	
			Power.	Total.		£	d.	£	d.	£	d.	£	d.	£	d.	£	d.	£	s.			
Fulham	19... April 2	1,107	70	740	08	65	10 10	65	10 10	74	4 8	4	1 3	4	10 0	209	16 4	4	0 0	143		
	June 10											2	1 6			4	1 3	10	0	187		
	July 27																					
	30.6.32		70	740	08	65	10 10	65	10 10	74	4 8	0	2 9	4	10 0	215	19 1	4	10 0		£211	0 1

FIG. 137.

VEHICLE COST SUMMARY

Vehicle A110.

Quarter.	Repairs.		Running.		Standing Charges.		Total.		Mileage.		Rate per Mile.		Amount Recovered.		Profit.		Loss.	
	£	d.	£	d.	£	d.	£	d.	£	d.	s.	d.	£	d.	£	d.	£	d.
19... March	138	14 6	146	4 7	51	4 6	338	3 7	6234		1	0	311	14 0	70	14 8	24	0 7
June	34	4 9	256	18 4	50	8 3	341	11 4	8216		1	0	412	6 0				

Note.—Accounts as the two above are kept for each vehicle.

FIG. 138.

GROUP COST SUMMARY

Group C.

Quarter.	Mileage.		Repairs.		Cost per Mile.		Running Costs.		Cost per Mile.		Standing Charges.		Cost per Mile.		Total.		Cost per Mile.	
	£	d.	£	d.	£	d.	£	d.	£	d.	£	d.	£	d.	£	d.	£	d.
19... March	540,672		8,264	19 2	3-61		14,846	18 8	0-48		0,847	1 11	2-99		20,958	19 9	13-08	
June	617,840		7,969	1 7	3-09		16,163	12 6	6-28		7,764	18 8	2-64		30,927	12 9	12-01	

A group cost of several cars which are alike.

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FIG. 132.

LEDGER ACCOUNTS Quarter ended March 31st, 19... *Paint Account*

19...		£	s.	d.	19...		£	s.	d.
Mar. 31	To Paint Materials. Painters' Tools, etc. .	147	7	9	Jan. 1	By Balance brought forward	21	6	6
"	" Balance carried forward			19 0	Mar. 31	" Charges recovered: 3387 hrs. at 2d..	127	0	3
		<u>£148</u>	<u>6</u>	<u>9</u>			<u>£148</u>	<u>6</u>	<u>9</u>

Breakdown Service Account

19...		£	s.	d.	19...		£	s.	d.
Mar. 31	To Sundry Charges .	46	16	7	Jan. 1	By Balance brought forward	6	1	7
"	" Balance carried forward	9	6	8	Mar. 31	" Charges recovered: Vehicle A/c.: £ s. d. A119 . . . 10 0 B76 . . . 3 0 0 Etc.	50	1	8
		<u>£56</u>	<u>3</u>	<u>3</u>			<u>£56</u>	<u>3</u>	<u>3</u>

Labour Charges Account

19...		£	s.	d.	19...		£	s.	d.
Mar. 31	To Holidays . . .	400	0	0	Jan. 1	By Balance brought forward	106	18	4
"	" Sickness . . .	560	16	7	Mar. 31	" Charges recovered: 147,164 hrs. at 3d.	1839	11	0
"	" Supervision . . .	250	14	4					
"	" Pensions . . .	308	8	1					
"	" Insurance . . .	320	16	6					
"	" Balance carried forward	95	13	10					
		<u>£1946</u>	<u>0</u>	<u>4</u>			<u>£1946</u>	<u>0</u>	<u>4</u>

FIG. 140.

MOTOR REPAIR JOB COST SHEET

Wagon	Vehicle - A119	Date: 2.4..
-------	----------------	-------------

for the current period, and a comparison with the same particulars in other periods corresponding :

<i>Car-Miles.</i>	<i>Passengers.</i>	<i>Goods.</i>
Number run.	Expenditure per person	Cost per ton-mile.
Number per hour.	carried.	Number of tons carried.
Expenditure per car-mile.	Receipts per person carried.	Weight per mile.
Receipts per car-mile.	Number carried at each fare (1d., 2d., 3d., etc.).	Etc.
	Cost per 100-seat mile.	

Comparative Cost Statements.—The method of summarising total costs for a period is shown in Fig. 141, which relates to Electric Tramway Costs, Fig. 142, Boiler House Costs, and on pages 452 and 453, Municipal Services.

(3) BOILER-HOUSE COSTS

The necessary statistics for arriving at the cost of steam produced and used are based on accounts prepared by the Cost Office and technical data provided by the Engineering Department as to steam pressures, evaporations, meter readings, and distribution to processes, factory heating, turbines, losses, etc.

Boiler-House Expenses.—The expenses may be considered under the following headings :

Supervision.—Wages of foreman, and a proportion of the works engineer's salary.

Labour.—Coal handling, stokers, and ash removers.

Maintenance.—Repair labour wages and materials. Furnace repairs, replacement of fire irons, grate bars, etc.

Indirect Materials.—Boiler-house service materials and small tools.

Fuel.—Cost of coal, including cartage, handling from waggons or barges, stacking and storage. The Engineering Department calculates the amount of coal needed for the operating hours for a given period, and issues purchase requisitions and specification. The purchase cost is notified to the Cost Office, and, from daily returns of coal consumed, the debit for each costing period is ascertained.

Water.—Cost of supply, softening plant, and purification. Any chemical purifiers may be included in this cost.

Fixed Overhead.—Rent, rates, depreciation, insurance, and interest, if included. It should be noted here that the capital value of the boiler-house plant is included in the rating assessment, whereas that in manufacturing machinery is not.

Statistical Reports by Engineer.—Daily returns as to boiler operations are required, such as the hours in use for each boiler, temperature readings, pressures, coal consumption in lbs., steam produced in lbs., evaporation per lb. of coal fired, average flow

BOILER-HOUSE COST SHEET
For the month of June 19...

S.O. Nos.	Expense Items.	Total Cost.		Cost per 1000 lbs. of Steam.				Incr. or decr. %.
		This Year.	Last Year.	This Year.	Last Year.	This Year.	Last Year.	
	Fuel	£	£	s.	d.	s.	d.	
	„ Handling							
	Ash Removal and Disposal							
	Electric Power							
	Stokers and Coal Wheelers							
	Water Purchased							
	„ Softening							
	Boiler Cleansing							
	Sundry Indirect Materials							
	Gas and Electric Light . .							
	Maintenance Services :							
	Fixed Plant							
	Meters							
	Boilers							
	Economisers							
	Softening Plant							
	Mechanical Stokers							
	Steam Service Pipes							
	Barrows							
	Weighing Machine, Tools, etc.							
	Coal Bunkers							
	Furnace							
	Miscellaneous Expenses :							
	Supervision							
	Sweepers, Cleaners, and General Labour							
	Rent, Rates, etc.							
	Depreciation Plant							
	„ Buildings							
	Renewals							
	Steam Mains							
	Allocation of General Charges							
	Total							
	Steam Pro- duced in 1000's lbs. :	Less Boiler House Use :	Less Mains Losses :	Total Consump- tion :				
Remarks :								

consumed, applying the charges as for a two-part tariff. (See also pp. 154, 275, and Fig. 105.)

EXAMINATION QUESTIONS

1. A large Store maintains a fleet of motor lorries for delivery purposes. Prepare a statement showing the costs of working in the manner in which, as Accountant to the Company, you would present these to the Board. You may supply for the purpose any figures or other information you think necessary.—*London Chamber of Commerce.*

2. A Department Store maintains a fleet of ten motor vans for its delivery service. On investigation you find the facts to be as follows :

The average cost of the vans was £1000 each.

Wages on vans amount to £4 10s. per week per van.

Total Garage Rent, Rates, Heating, etc., are £390 per annum.

Total Garage Wages are £200 per annum.

Repairs to vans cost £1250 per annum.

Depreciation 20 per cent. per annum.

Tyres are dealt with by contractors at a cost of £50 per annum per van.

Petrol costs £1100 per annum for the fleet.

Oil and Stores cost £600 per annum.

Insurance, all risks, for the fleet £200 per annum.

Licences £550 per annum.

The average run of each van is 350 miles per week. For the purpose of this question it may be assumed that total costs can be allocated equally over the ten vans.

State your views as to the periodical returns of working which should be submitted to the Management, and, from the information given, draft the first of such returns.—*London Chamber of Commerce.*

3. A company owns ten motor omnibuses running on five different routes in the same city. The management wish to have a weekly statement of working, and, in particular, wish to consider whether or not it would pay them to withdraw the buses from certain routes.

Prepare, supplying yourself any figures necessary, the statement for last week, and indicate the sources from which, in practice, you would obtain the figures.

Would you make any, and if so what, use of a chart or charts in this case?—*London Chamber of Commerce.*

4. What system of Costing is usually adopted, and for what reasons, in the following :

Railway Companies;

Gas and Power Undertakings;

Hospitals?

Society of Incorporated Accountants and Auditors (Final).

5. In Railways, etc., it is usual to work out :

(a) The cost per mile run. Draft an abstract, using imaginary figures, giving the average cost per mile.

(b) To what use are the figures put for standardisation purposes?—*Society of Incorporated Accountants and Auditors (Final).*

6. Show, with as much information as possible, a cost sheet of a motor transport company handling passenger and goods traffic, using petrol or steam vehicles, or both.—*Institute of Cost and Works Accountants (Final).*

CHAPTER XXIII

OPERATING COSTS (*continued*)

(4) ELECTRICITY SUPPLY COSTING

The cost of operating an Electricity Supply Undertaking can be considered under two main heads :

1. The generation or production of the electrical energy.
2. The distribution of this from the power station to the consumer.

It will be convenient to deal with each portion separately.

Uniform Costing for Generation.—The passing of the Electricity (Supply) Act, 1926, and the subsequent setting up of the Central Electricity Board, have resulted in the Electricity Supply Industry adopting, so far as the production side is concerned, a uniform method of costing. The Board can be regarded as an administrative organisation, charged with the duty of supplying to authorised undertakers at cost price, in accordance with the provisions of a scheme prepared by the Electricity Commissioners. The owners of a generating station, if selected for the purpose, are to operate the station as, and when, the Board may direct, and to conduct such operations with due regard to economy and efficiency. They must sell to the Board all electricity generated at the station, the price paid by the Board being the cost of production.

Official Cost of Production Rules.—The Second Schedule of the Act enumerates the rules for determining the cost of production as follows :

(a) The sums expended for fuel, oil, water, and stores consumed, for salaries and wages, and any contributions for pensions, superannuation, and insurance of officers and servants, for repairs and maintenance of buildings and plant, and for renewals not chargeable to capital account ;

(b) Sums paid as rents, rates and taxes (other than taxes on profits), and for insurance in respect of the station ;

(c) The proper proportion of management and general establishment charges of the station ;

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FIG. 144.

MAINTENANCE ACCOUNTS

Sub-heading.	Further Sub-divisions	
Boilers.	Boilers. Air Ducts. Boiler Brickwork. Boiler Framework. Boiler Fittings. Boiler Meters. Chimneys (Steel). Economisers. Fans (Mechanical portions of). Flues.	Preheaters. Pulverised Fuel Burners. Reheaters (separately fired). Soot Blowers. Stokers. Superheaters. Tubes. Walls. Water Screens.
Engines.	Main and House Turbines and Condensers.	
Other Mechanical Plant.	Air Compressors. Air Extraction Plant. Cranes (other than Fuel and Ash Handling Cranes). Evaporators. Extraction Pumps. Feed Pumps. Feed Ranges and Valves. Feed Water Heaters. Feed Water Treatment Plant. Fire Fighting Equipment.	Hotwells. Oil Filtering Plant. Pumps (General Service). Repair Shop Equipment. Steam Accumulators. Steam Ranges and Valves. Steam Receivers. Tanks. Testing Equipment. Transformer Oil Pumps and Coolers.
Generators.	Generators. Air Coolers. Air Filters. Alternator Air Ducts. Alternator Fans. Alternator Main Transformers.	Exciters. Exciter Sets. House Service Alternators. Main Alternators.
Other Electrical Plant.	Auxiliary Driving Motors. Cables (Main and Control). Charging Sets. Converting Plant and Batteries used for Generation. Internal Telephone Equipment.	Meters. Reactors (where connected to Generation). Relays. Switchgear. Wiring and Electrical Heating and Lighting Equipment. Works Transformers.
Buildings.	Buildings. Bins, Racks, etc., in Stores. Chimneys (Brick and Concrete). Domestic Water Sup-	Furniture. Water or Steam Heating Installation. Wells used exclusively for feed water.

MAINTENANCE ACCOUNTS (*continued*)

Circulating Water Plant.	Auxiliary Plant.	Pumping	Pipe Lines.
	Circulating Screens.	Water	Reservoirs.
	Circulating Treatment Plant.	Water	Sprayers.
	Intake and Culverts.	Outlet	Towers.
			Wells (other than those used exclusively for feed water).

only, such as stokers, drivers, switchboard attendants, etc. Wages of workmen engaged on the repairs and maintenance of plant and buildings are charged direct to such heads.

(7) *Repairs and Maintenance.*—This includes costs of material, labour, and contract work allocated under the sub-headings set out in Fig. 144.

(8) *Renewals not chargeable to Capital Account.*—These costs are sub-divided in the same way as Repairs and Maintenance, and include such items as replacements of worn-out parts, etc.

Note.—Employers' contributions under the Insurance Acts, Workmen's Compensation Acts, and for superannuation are allocated to the appropriate salaries and wages, and included under the above items.

(b) *Overhead Charges.*—All overhead charges for production are the subject of an estimate at the commencement of the Board's financial year. One-twelfth of the estimate is charged each calendar month and the adjustment with actual cost incurred is made at the close of the twelfth month. The items which make up total overhead costs are :

(1) *Management and General.*—The procedure is to charge in detail all management expenses to a total management account which is inclusive of both generation and distribution. Items which make up management are : salaries of staff not wholly employed on generation or distribution, printing and stationery, law and valuation expenses, etc. The portion of the management costs chargeable to production is based on the capacity of the generating station. The prescribed amount is 2s. per kilowatt of installed capacity, plus £500 per annum, or 2s. 3d. per kilowatt per annum, the choice being left to the discretion of the Generating Authority. That is to say, a station that could meet a demand of, say, 50,000 kilowatts at any one time, could charge to production either £5500 or £5625 per annum. The latter would probably

be charged, as it is of course recoverable from the Central Electricity Board. The remainder of the total of management expenses is chargeable to distribution.

(2) *Rents*.—These include such rentals as the ground rent of the generating station site, rentals of land used for ash disposal, siding rents, etc.

(3) *Rates*.—Most Electricity Supply Authorities are assessed for rates on the profits of the undertaking as a whole. The method of apportionment most favoured is the division of the rateable value in proportion to capital value of generation works and other works.

(4) *Insurance*.—The premiums charged to production are for policies such as fire insurance, boiler insurance, etc., which belong to generation solely.

(5) *Interest*.—This covers interest on all expenditure attributable to the generating station and plant. In general, plant on the generator side of the station bus-bars is included, but distribution plant housed in the station for convenience (*e.g.* convertors, transformers, and switchgear used for controlling supplies taken from the station) is excluded. Interest on working capital is included under this head, and is based on the monthly cost of production totals.

(6) *Depreciation Allowance*.—In the case of a local authority, the depreciation allowance is an amount equal to the sinking-fund charges properly attributable to the generating station and plant. Where the owners of the station are a company, an amount determined in accordance with a scale fixed by special order is charged.

The Unit of Cost.—The above represents “cost of production.” The unit of cost for presenting production cost data is the Board of Trade kilowatt-hour or unit of electricity generated. That is to say, the values shown under the cost headings enumerated above are divided by the number of units generated during the period, and presented as cost in pence per unit.

The following is an example of a monthly cost statement (with dummy figures) for presentation to the Central Electricity Board.

It may be as well to explain that the “unit” of electricity is 1000 watts (1 kilowatt) of current for 1 hour—hence the alternative term of “kilowatt-hour.” The quantity of watts is the result of multiplying amperes \times volts, the amperes being

A.—WORKS COSTS				Details.	£	Per Unit.
Fuel Consumed—				£		Pence.
(a) Coal	9,754 tons at	14/2	per ton	6,909		
(b) Coke	..... tons at	.....	per ton			
(c) Oil	..... tons at	.....	per ton			
(d) Gas	..... thou. cu. ft. at	.....	per 1,000 cu. ft.			
(e) Refuse, etc.						
Total					6,909	0-1495
(f) Fuel Handling and Storage Charges				174		
(g) Fuel Preparation Charges						
(h) Ash Handling Charges				122		
(i) Flue Gas Treatment Charges				20		
(j) N.H.I., etc.				13		
Total					329	0-0071
Total					7,238	0-1566
Less (k) Proceeds of Sale of Ashes, etc.				205		
(l) Proceeds from Sale of Steam						
Total					205	0-0044
Total Fuel					7,033	0-1522
Steam Purchased						
Lubricating Oil, Water, and Stores Consumed—						
(a) Oil and Stores				10		
(b) Water :—						
(i) Charged by Meter	810	thousand gals.		35		
(ii) Other Variable Charges						
Total Oil, Water, and Stores					45	0-0010
Salaries and Wages of Generating Station Staff (Operation only)					792	0-0171
	Salaries and Wages.	Materials.	Contract Work.	Total.		
Repairs and Maintenance—	£	£	£	£		
(a) Boilers	310	66	32	408		
(b) Engines	19	153		177		
(c) Other Mechanical Plant	69	19		88		
(d) Generators	6	15		21		
(e) Other Electrical Plant	72	40	35	147		
(f) Buildings	98	46		144		
(g) Circulating Water Plant	6	22		28		
(h) Salaries						
(i) N.H.I., etc.	32			32		
Total Repairs and Maintenance	612	366	67	1045	1,045	0-0226
Total Works Costs					£8,915	0-1929
B.—OVERHEAD CHARGES (Generation only)						
Agreed Monthly Estimate					4,356	0-0942
Non-Recurring Revenue Expenses—						
(a) Charges re Loans					13	0-0003
(b)						
(c)						
Total Overhead Charges					£4,369	0-0945
Total Costs					£13,284	0-2874

the amount of current and the volts being the pressure of the current.

Two-Part Costs.—The total cost of producing electricity is made up of two distinct parts, owing, largely, to the fact that electricity cannot be manufactured uniformly, and placed into stock, until a customer is found. The rate of output is dependent upon the immediate demand, and is produced accordingly. Consequently, the rate of demand, and the time it occurs, influence considerably the cost at which the current can be produced, and, of course, at which it can be sold. The two parts are :

(1) The fixed or standing charges which are dependent upon the maximum rate of demand (maximum load in kilowatts) and independent of duration of demand or hours of use.

(2) The running charges which are proportional to the number of kilowatt-hours, or Board of Trade units.

(a) *The Fixed Charges.*—The cost of providing the capital that has been expended on generating plant, buildings, etc., which comprises such charges as interest, loan repayment, depreciation, etc. The fixed charges also embrace the cost of coal required to keep up the temperature of boilers, salaries and wages of that part of the staff necessary for keeping steam up in boilers, and machinery in readiness to supply. All these charges are fixed, no matter how much, or how little, the plant is in use, but they do bear a relationship to the maximum load in kilowatts on the generating station, and hence this cost can be properly expressed in terms of a fixed charge per month (or other period), in pounds or shillings per kilowatt of maximum demand.

(b) *The Running Charges* include coal for steam other than that required for stand-by losses, wages over and above the stand-by wages previously referred to, a large proportion of repairs and maintenance of plant, etc., and oil, water, and sundry stores. Each unit produced involves an amount of cost in coal, wages, stores, etc. (i.e. running charge-), which can be definitely expressed as a cost per unit.

The Load Factor.—The division of the costs between stand-

ing and running charges is based on the load factor of the generating station which is :

$$\frac{\text{Units generated} \times 100}{\text{Maximum Demand in kilowatt} \times \text{hours of supply period}}$$

Example :

$$\frac{3,800,000 \times 100}{18,400 \times 720} = 28.68 \text{ per cent.}$$

In other words, the load factor is the ratio of actual output in units generated to the possible output if the maximum load demanded were continually in use throughout the period of supply.

Division of Cost based on Load Factor.—The load factor is applied by agreed formulæ to the different classes of cost, and the division is made accordingly.

Let us take an actual example. (Fig. 145.)

FIG. 145.

Class.	Total cost for month.	Per cent. charged to Standing Costs say.	Standing Costs.	Running Costs.
	£		£	£
Fuel	3200	10	320	2880
Oil, Waste, Water, etc.	25	20	5	20
Salaries and Wages	600	90	540	60
Repairs and Maintenance	450	70	315	135
Management Proportion	400	100	400	—
Rents, Rates, and Insurance	480	100	480	—
Interest and Depreciation	2500	100	2500	—
Totals	<u>£7655</u>		<u>£4560</u>	<u>£3095</u>

Assume a generating station with an output in units for the month of 3,800,000 has a maximum demand on station of 18,400 K.W.

By dividing the standing costs by the maximum demand, $\frac{£4,560}{18,400}$, and the running costs by the units generated, $\frac{£3,095}{3,800,000}$, we get: 4s. 11d. per kilowatt of maximum demand, plus 0.1955d. per unit, as our cost of production during the month.

The example quoted above is in a simplified form, but should be sufficient to explain the general principle. It is of interest to note that the price at which a "selected" station Authority may purchase supplies from the Board is based on this principle.

The Cost of Capital Works.—Special attention is given to the costing of capital works, and the form of assembly and presentation is based on the requirements of the Electricity Commissioners. Application for sanction to borrow for capital works is, first of all, made to the Commissioners, and expenditure has to be accounted for in a specified form. The examples for mains (Figs. 147 and 148) will convey to the reader some idea of what is necessary.

Tariffs.—The tariff of charge to the consumer for electricity supplied to him must bear some relation to the cost to the Electricity Undertaking. From the preceding remarks in this chapter under "Two-part Costs," it will be evident that every consumer or class of consumer involves the supply undertaking in two expenses:

(1) Each consumer's installation requires that a definite amount of plant shall be in readiness in the supply station to meet the requirements of that particular consumer. The cost of this may be met by charging the consumer a fixed charge per annum based on his maximum demand.

(2) A running charge, varying with the actual amount of energy consumed, which may be met by an additional charge to the consumer of so much per kilowatt hour or Board of Trade unit.

Note.—The division of generation costs into two parts is set out, under broad headings, in Fig. 145.

The demand from the different classes of consumers varies considerably, and hence the widely different rates for supply that make up an Electricity Supply Authority's scale of charges. The two-part tariff which is now so popular with the industry, and which charges a fixed amount per quarter, plus a charge per unit consumed, is the nearest attempt to base the charge to the consumer on the principles of cost. This method is, of course, rather more complicated to the consumer than the simple flat-rate method, and it might be argued that it is seldom satisfactory to sell on a cost basis, as the value of the commodity to the purchaser must always be taken into account. The success of modern Electricity Undertakings is largely dependent on the choice of suitable tariffs for each and every class of consumer, and this question always receives a great deal of attention by the industry in general.

FIG. 147.

DIAPYCNES (Particulars of Cables)

Period covered by Expenditure	Size of Cable.	Type and Voltage.	Method of Laying.	Total Length of each Size of Cable.	Average Cost per Yard of each Size of Cable.			Total Expenditure on each Size of Cable each Half- year.		
					£	s.	d.	£	s.	d.
				Yards.	£	s.	d.	£	s.	d.

Fig. 148.

MAINS (Summary Statement)

[illegible]

- (a) Power supply ;
- (b) Trolley bus operation.

Institute of Cost and Works Accountants (Final).

10. A factory distributes its products by motor transport over a wide radius and utilises return journeys for purchased materials, empties, etc. On what bases would you allocate cost over inward and outward journeys?—*Institute of Cost and Works Accountants (Inter.).*

CHAPTER XXIV

STANDARD COSTS

Standard Costs are pre-determined, or budgeted, estimates of cost to manufacture a single unit, or a number of units of a product, during a specified immediate future period. They are used as a measure with which the Actual Cost, as ascertained, may be compared. In some systems all the costing is figured at standard rates, the cost resulting being afterwards converted to Actual by means of ratios.

Standard Costs are usually the planned costs of the product under current and anticipated conditions, but, sometimes, they are the costs under normal or ideal conditions of efficiency, based upon an assumed given output, and having regard to current conditions. They are revised to conform to supernormal or subnormal conditions, but more particularly to allow for persisting alterations in the prices of material and labour.

Standard Costing is a method of detailing the costs whereby statistics are prepared detailing : (a) the Standard Cost ; (b) the Actual Cost ; and (c) the ratio between these costs, for every product.

The standards cannot be fixed by total production, if adequate control is to be made possible, but by arriving at separate departmental or process costs; in fact, it may be necessary to subdivide still further, *e.g.* to the cost of operating each individual machine.

It will be obvious that when first deciding upon standards, much careful analysis and consideration of costs are demanded, but afterwards the work is not more, and often is less, than in many of the less modern cost systems in use to-day.

The Presentation of Facts.—There are several methods of showing or using the Standard Costs in the Statistics and Accounts, but the most usual one is to record the Standard and Actual Costs for each item in adjacent columns. This permits of ready and detailed comparison, both item by item, and in totals.

The Utility of Standard Costs has been widely recognised in recent years, particularly in the United States, and, to a considerable extent, in Great Britain. In the principal factories in this country producing on a large scale, as, for instance, in the textile industry, electrical and other engineering, biscuit-making, and chemical industries, Standard Costs are in use, and there is every indication that Standard Costing will be used to a very large extent in future.

Much depends upon the arrangement of the records as to whether a Standard Costing system entails additional clerical work. In some instances it has resulted in less work. In a certain American factory making a standard product, cost variances only are recorded. It may be said that, even if the procedure does involve additional clerical work, the close control effected enables considerable saving to be made in production costs.

Standard Costing can be introduced most advantageously in process, unit operation, and mass-production costing, or whenever there is repetition production, but not in those factories where dissimilar non-recurring jobs are undertaken.

The Chief Advantages secured may be summarised as follows :

(a) Actual performance is readily comparable with the pre-determined standards, showing separately profits or losses thereon on different classes or units of manufacture.

(b) Variations from standard can be detected in detail,

Cost Office Procedure.—Requisitions are summarised, one summary being at Actual, the other at Standard. The Actual Cost Summary total is credited to Material Control Account, and debited to Material Variation Account. The Standard Cost Summary total is credited to Material Variation Account, and debited to work in Progress Control Account.

The requisitions are analysed under works order numbers, and posted to the debit of the Cost Accounts therefor.

FIG. 154.

STORES MATERIAL CONTROL ACCOUNT
(at Actual Cost)

Dr.					Cr.				
19...		£	s.	d.	19...		£	s.	d.
Jan. 1	To Balance b/d.				Jan. 31	By Issues for Month to Orders (at Cost) *			
" 31	" Purchases				"	" Balance c/d.			

STORES MATERIAL VARIATION ACCOUNT
(at Standard and Actual)

Dr.					Cr.				
19...		£	s.	d.	19...		£	s.	d.
Jan. 31	To Issues at Actual as per Abstract *				Jan. 31	By Issues transferred to Work in Progress at Standard			
					"	" Balance to P. & L. A/c.			

* These two figures are the same totals.

WORK IN PROGRESS CONTROL ACCOUNT
(at Standard)

Dr.					Cr.				
19...		£	s.	d.	19...		£	s.	d.
Jan. 1	To Balance b/d.				Jan. 31	By Finished Stock A/c. (at Standard)			
"	" Issues (Standard)				"	" Balance, being Work in Progress (at Standard)			
"	" Labour (Standard)								

This procedure keeps the Work in Progress Account at Standard Cost, and the Stores Material Account at Actual.

(b) *Labour.*—In Standard Costing procedure direct labour is usually paid at piece-rates or bonus rates; indirect at day-rates.

The procedure for recording gate time and job times has already been described. The total of the pay-roll, and that of the labour abstract, should be agreed.

Cost Office Procedure.—Two accounts are opened in the Cost Ledger: (1) Standard Labour Account; (2) Labour Variation Account.

The Labour Wages Abstract, based on job tickets priced at Standard, is totalled, and debited to Standard Labour Account.

There will only be labour wage variations if a change has been made in premium bonus or piece-rates, or if a job has been done at day-rate wages, although, normally, done at premium bonus or piece-work rates.

Any variation which does occur will be debited, or credited, to the Labour Variation Account, according to whether the difference is over or under standard.

The debit to Work in Progress is at Standard.

The general procedure is on the same lines as for materials.

(c) **Overhead (= Oncost).**—The many items of fixed and Variable Overhead make it difficult to get an exact distribution of it to the shops and the products; even though a time basis, machine-hour, or direct wages basis, may be used. The use of Standard rates, based on past record, but modified by the trend of the immediate future, is a usual method of procedure, which will need no alteration. The chief point to observe is that separate rates are fixed for each shop, and, usually, for each machine, or production centre.

Fixed charges, such as rent, depreciation, interest on capital, etc., continue whatever the output. Variable Overhead varies substantially, but not exactly, in proportion to output. For these reasons it is often the practice to apply fixed and variable overhead by separate rates.

Overhead Control Account is debited with Actual expenses, and credited with Standard expenses recovered on the works orders, etc. The Work in Progress Account is also debited with the Standard recoveries in total.

There is, usually, a difference on the Overhead Control Account, due to over or under recovery of expense. This balance is transferred to Overhead Adjustment Account, thus clearing the account.

The Adjustment Account is closed by transferring the balance of it to the Profit and Loss Account at the end of each accounting period. It may be noted that this account is sometimes called "Over- or Under-Applied Expense Account."

(d) **Standard Cost Record Sheet.**—This is used for compiling the Standard Cost. When there are a number of components made or purchased, and these are eventually assembled into one complete unit, a separate cost sheet must be written up for each part, and one for the assembled product.

The specimen given in Fig. 155 is completed for the costs of each component. Each component Cost Sheet shows the

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STANDARD COST RECORD SHEET

(for Component Parts)

STANDARD COST RECORD SHEET

(for Assembly Units)

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standard cost per unit. The component costs are used for the assembling cost, for which Fig. 156 is a suggested form. In other words, the component Standard Cost Record Sheets provide the standard cost figure per unit for each component made; from these the assembled unit cost is built up, as shown in the example.

(e) **A Set of Standard Cost Control Accounts.**—These show the operation of the method described, and are sufficiently annotated to be self-explanatory.

STANDARD COST CONTROL ACCOUNTS

(1) Stores Material Control Account

Dr.			Cr.		
To Stock on Hand	b d.	£ 600	By Issues as per Abstract, at Actual (Direct)	To 2	1000
" Purchases for Month at Actual		3000	" Do. (Indirect) to Factory Overhead	To 3	2000
			" Balance, Stock on Hand	c/d.	3000
		<u>£3600</u>	(all at actual)		<u>£6000</u>

(2) Stores Material Variation Account

Dr.			Cr.		
To Issues to Jobs at Actual	a, c, l.	£ 4000	By Issues to Jobs at Standard as per Work In Progress A/c.	To 6	3800
			" Balance, being difference between Actual and Standard transferred to Profit and Loss A/c.	J	200
		<u>£4000</u>			<u>£4000</u>

(5) *Factory Overhead Control Account*

Dr.				Cr.			
To Indirect Material at Actual	Fr. 1	£ 2,000	By Overhead recovered by Rates at Standard (Total debited to Work in Progress A/c.)	To 6	£ 7,800		
" " Labour at Actual	Fr. 3	1,800	" By Profit and Loss A/c., difference between Actual and Standard, under-recovered	J	200		
" " Other Expenses (Actual)	J	1,200					
" " Fixed Overhead (Actual)	J	3,000					
		<u>£8,000</u>			<u>£8,000</u>		

(6) *Work in Progress Control Account*

Dr.				Cr.			
To Balance in Progress	b/f.	£ 6,000	By Completed Work to Finished Stock A/c. at Standard	To 7	£ 16,700		
" Direct Material Issues at Standard	Fr. 1	3,800	" Balance, Work in Progress, at Standard	c/d.	4,000		
" Direct Labour at Standard	Fr. 4	3,100					
" Factory Overhead charged to Jobs at Standard Rates	Fr. 5	7,800					
		<u>£20,700</u>			<u>£20,700</u>		

(7) *Finished Stock Control Account*

Dr.				Cr.			
To Balance, Stock on Hand, at Standard	b/f.	£ 9,200	By Issues against Sales Orders, to Cost of Sales A/c at Standard	J	£ 17,800		
" Completed Work from Work in Progress A/c.	Fr. 6	16,700	" Balance on Hand at Standard	c/d.	8,100		
		<u>£25,900</u>			<u>£25,900</u>		

EXAMPLE II

Accounting in Standard Values.—In this method all entries in the accounts are at Standard prices or rates, the conversion to Actual being effected by adjustment of totals, and the transfer of the amount of variations to Cost Variance Accounts.

Procedure for Standard Costing. (a) *The Purchase Journal.*—The usual columnar journal is used, but a column for standard cost values is added. (Fig. 157.)

As Invoices are passed against the Goods Received Notes, the Standard price is entered under the Actual, ready for the journal clerk.

The Actual values are entered in the first and second columns in the usual manner, the Standard values in the third column. The extension into the analysis columns is at standard for Stores Materials, but at Actual for all the columns provided

for expense items. These totals are debited in the Cost Control Accounts, see pp. 374-375.

At the end of each week or month the difference between

FIG. 157.

PURCHASE JOURNAL

[illegible]

FIG. 158.

STORES MATERIAL ACCOUNT
(Standard Values)

Dr.						(Standard Values)						Cr.		
19...				£	s.	d.	19...				£	s.	d.	
Jan. 1	To Balance	.	b/d.	9,366	0	0	Jan. 31	By Issues as per						
" 31	" Purchases	.	J3	3,556	10	0	"	" Abstracts	J1		4,017	0	0	
							"	" Balance	c/d.		8,005	10	0	
				£12,922	10	0					£12,922	10	0	
19...														
Feb. 1	To Balance	.	b/d.	8,005	10	0								

FIG. 159.

MATERIALS COST VARIANCE ACCOUNT

MATERIALS COST VARIANCE ACCOUNT											
Dr.						Cr.					
19...			£	s.	d.	19...			£	s.	d.
Jan. 1	To Balance (Variance on Stock in Hand)	b/d	279	5	6	Jan. 31	By Variance* on Issues as per Abstracts	J4	381	0	0
" 31	" Variance on Purchases	J4	159	4	6	"	" Balance			10	0
			2438	10	0				2438	10	0
19...											
Feb. 1	To Balance	b/d	381	10	0						

- Transferred to Cost Variance Control Account.

totals of materials purchased is found, and posted to a Material Cost Variance Account. (Fig. 159.)

If required, a separate account may be kept for each class of material.

Materials Issued from Store.—These are made in the usual

way against requisitions. When pricing out these issues in the Cost Office, the Actual and Standard prices are entered.

The various materials accounts in the Stores Ledger are credited at both values, the individual Cost Accounts being debited, and the totals are also credited to Stores Material Account, as shown above (Fig. 158), and debited to Work in Progress Account, at Standard value. The variance between Actual and Standard is posted to the Materials Cost Variance Account (debit or credit according to which is greater, Actual or Standard). (Fig. 159.)

Labour Wages.—These are dealt with on the same lines.

Factory Overhead.—Allocations to shops and to jobs or

Fig. 160.

CONTROL COST VARIANCE ACCOUNT

Dr.					Cr.				
19...			£	s. d.	19...		£	s. d.	
Jan. 1	To Balance . . .	b/d.	485	10 0	Jan. 31	By Variance on Fin- ished Stock, to Cost of Sales A/c.	J4	104	2 0
Jan. 31	„ Variance on Stock	J4	177	10 0		„ Overhead Over- recovered to Profit and Loss A/c.	J5	70	0 0
„	„ Variance on Ma- terials Issued . .	J4	57	0 0	„	„ Balance . . .	c/d.	545	18 0
			£720	0 0				£720	0 0
19...									
Feb. 1	To Balance . . .	b/d.							

processes are at Standard pre-determined rates, as budgeted. The under- or over-allocated overhead as revealed by the Overhead Control Account is transferred to Cost Variance Account.

Completed Work is credited to Work in Progress at Standard Cost. These totals are debited to Finished Stock Account.

Cost of Sales Account.—On issuing finished stock the Standard price is converted, by means of the ascertained ratio of Standard and Actual, to Actual values.

The Cost Variance Account (Fig. 160).—The balance of this account shows the net cost variance on production, plus the variance on Cost of Sales.

The balance on the Materials Cost Variance Account added to (or deducted) from the balance of Materials Account gives the Actual value of stock on hand. Similarly, with Finished Stock Account.

The Variance on Overhead Expense Control Account represents the difference between budgeted and Actual expense

incurred. The Control Cost Variance Account (Fig. 160) is closed at the end of the month by crediting the variance transferred to the Cost of Sales Account. If over- or under-allocation of Overhead is included in this account, the amount is transferred to Manufacturing or Profit and Loss Account.

The balance remaining on the account represents the variance on materials and stock on hand, and is carried down as a balance.

FIG. 161.

ACTUAL COST SUMMARY

Route :				Order No. :			
Date :				Code :			
Description :				Qty. :			
	Actual Cost of Order.			Actual Cost per 1000.			Standard Cost per 1000
	£	s.	d.	Dec. of £			Dec. of £
Manufactured Material							
Purchased Material							
Labour							
Overhead							
Total Cost							
Standard Cost Variation Efficiency.	Standard Cost of Order.			Standard over Act. Cr.			Actual over Std. Dr.
	£	s.	d.	£	s.	d.	£ s. d.

The final accounts (Manufacturing and Profit and Loss Accounts) are then completed in the usual manner.

A Specimen Cost Summary.—The form shown in Fig. 161 is an Actual Cost Summary for a Works Order completed. It shows to what extent the Actual cost has varied from the Standard.

Checking Stores Records.—It should be noticed that the use of Standard pricing of stores materials enables balancing to be effected either in money values or quantities, because, by dividing the money value balance of any particular class of material by the price, the quantities can be checked. This is not possible when varying actual prices are used.

EXAMPLE III

ACCOUNTING IN STANDARD AND ACTUAL VALUES WITH RATIOS

In this method the records are entered at Actual and Standard values in adjacent columns, together with the ratio.

Materials.—A total Control Account for stores materials is kept. In the Stores Ledger the account for each class of material is ruled to show Standard and Actual cost and the cost ratio. The balances of the accounts in the Stores Ledger should agree in total with the balance of the Materials Control Account.

Costing Issues of Materials.—Standard prices are entered on the requisitions in the Cost Office, together with the current ratio between Standards and Actual.

The totals, from the Materials Abstracts, are credited to Materials Control Account (see p. 374), and debited to Work in Progress Account, at both values.

The issues to various works order numbers are debited thereto, and credited to the respective Materials Accounts in the Stores Ledger, at both Standard and Actual prices.

Materials issued for Standing Orders are charged at Actual prices.

A Stores Ledger Account on these lines is shown in Fig. 162.

Charging Labour and Overhead.—For job order work a job-card is issued to the worker for each operation. The time occupied in doing the work is recorded, together with the number of articles passing inspection. The day-rate, bonus rate, or piece-work price is entered by the Cost Office, and a summary of these cards for each worker forms the basis for the pay-roll. A special column is provided for Standard Cost based on a labour-hour or piece rate at Standard price.

Overhead is added on the card. The total so added to all jobs is credited to Overhead Control Account.

The total of labour wages paid is debited to Work in Progress. (Fig. 163.)

Completed Orders.—These are summarised monthly and credited at Standard and Actual to Work in Progress (see Fig. 163); corresponding debits are made to Components Stock Account, and Finished Stock Account.

Cost of Sales.—The Standard Cost of goods issued against

FIG. 162.

STONES LINGER ACCOUNT (STANDARD COSTING)
1-in Steel Tubes. Code S. 102

Dr.	19... Jan. 1	To Balance b/d.	Standard.		Ratio.	19... Jan. 31	By Issues " Balance	Fo.	Actual.		Ratio.	Cr.
			£	s. d.					£	s. d.		
	" 31	" Purchase.	625	0 0	105			13	200	0 0	105	
			250	0 0	105.5			c/d.	675	0 0	105.2	
			£875	0 0					£875	0 0		
	19... Feb. 1	To Balance b/d.	675	0 0	105.2							

FIG. 163.

WORK IN PROGRESS ACCOUNT

19... Jan. 1	To Balance b/d.	Standard.		Ratio.	19... Jan. 31	By Components Stock A/c. " Finished Stock A/c. " Balance	c/d.	Actual.		Ratio.
		£	s. d.					£	s. d.	
	" Materials	302	0 0	103.4						
	" Wages	384	0 0	101.6						
	" Overhead	433	10 0	102.4						
		326	10 0	102.3						
		£1446	0 0					£1446	0 0	
				109.0						

sales orders is entered on the duplicate of the invoice, or other record is kept.

By grouping like kinds of goods it is sometimes possible to apply the converting cost ratio to the totals. If not, this has to be done for the total of each type of stock sold. The Standard Cost is multiplied by the cost ratio to convert the total to Actual value for the Trading Account.

Standard Costing and Mechanical Tabulating.—The use of tabulating and sorting machines, such as the Powers or Hollerith, considerably facilitates prompt and accurate accounts and statistics. Material requisitions made on cards for punching speed up the summarising and sorting by materials at Actual and Standard, and by product classes. Labour efficiencies are readily ascertained, and also the cost variations on shop orders, a procedure which is slow when done by hand.

The example in Fig. 164 is a card actually used for arriving at cost variations from standards by a company making plated electrical components.

Standard Prices and Rates List.—For the purpose of pricing materials, components, etc., a schedule of standard prices and rates is compiled for use by the Standard Cost Clerk.

the future period of working, to which it relates? Give your answer fully.—*Institute of Cost and Works Accountants (Final)*.

9. What is meant by Standard Costs; in what circumstances may they be safely employed; what advantages do they offer?—*Institute of Cost and Works Accountants (Inter.)*.

10. What is meant by the expression "pre-determined costs"? For what purposes are they used and how are they prepared?—*Institute of Cost and Works Accountants (Inter.)*.

11. Describe fully the basis upon which Standard Costs are obtained and state their uses to the management. Illustrate your answer with an example.—*Institute of Cost and Works Accountants (Inter.)*.

12. Define the following terms:

- (a) Standard Costs as applied to a product.
- (b) Uniform Costs as applied to an industry.
- (c) Process Costs.
- (d) Test Costs.

Institute of Cost and Works Accountants (Final).

13. In drawing up a scheme of Budgetary Control, what considerations should be taken into account, and how should they be provided for?—*Institute of Cost and Works Accountants (Final)*.

14. Three Feeder Departments supply the manufacturing departments at pre-determined cost prices. At the end of the financial year two have made a book profit of £3,000 and £8,000 respectively, and the other has made a loss of £2,700. How would you deal with this situation?—*Institute of Cost and Works Accountants (Final)*.

15. In valuing inventories should Standard Cost be used instead of actual cost, or market price, if the Standard Cost be lower than either of these? State your reasons.—*Institute of Cost and Works Accountants (Final)*.

16. In dealing with Material Costs, outline the advantages and disadvantages of using Standard Cost methods.—*Institute of Cost and Works Accountants (Inter.)*.

17. Discuss "Standard Costs," their advantages and disadvantages, and the conditions under which you consider their adoption to be of greatest use. Indicate the circumstances under which the use of Standard Costs could be misleading.—*Institute of Cost and Works Accountants (Final)*.

CHAPTER XXVI

MECHANISED COST ACCOUNTING

The Punched-Card System using Sorting and Tabulating Machines.—The fundamental principle of punched-card accounting is the provision of an item of original entry in such a form that it can be reproduced, either singly or in conjunction with other entries, at any time, in any form, by means of a machine, thus avoiding the laborious compilation of subsidiary entries. It is achieved by punching holes in cards of uniform size in fixed positions having a numerical significance. This accounting medium, the punched card, is made to operate high-speed sorting and tabulating machines which sense the perforations and transcribe them into printed accounting and costing records.

The Punched-Card System is ideally suited to the needs of cost accounting, which is essentially a science of analysis and synthesis, and it is not surprising that there has been, during recent years, a remarkable and world-wide expansion in the use of punched-card machinery for this purpose.

The outstanding advantages of the system are its speed, flexibility, and accuracy. It is far quicker than hand-written methods, and statistics which are essential to efficient management are more easily obtained. The time taken in punching information into a card is much less than would be taken to write the same information, and there is the added advantage that once the card has been punched and verified, it becomes the medium for all subsequent entries. Thus a credit posting to the Stores Ledger and its corresponding debit entry to the Job Costs or Expense Account are both provided by one and the same card containing the details of materials issued from Stores. The punching of the card cannot be altered or erased, and therefore the records obtained from it are not liable to errors and alterations in copying.

There are two mechanised punched-card systems, the Hollerith and the Powers. They differ principally in their method of functioning, for whereas with the Hollerith the sensing of the cards is by electrical contact through the holes punched in them, with the Powers the sensing is mechanical by means of pins passing through the holes.

WEEK T	GROUP	SHOP			OPN.	HOURS			WORKER			TIME			P.W.B.			TOTAL			ORDER NO.										M	
		20	40	60		20	40	60	20	40	60	20	40	60	20	40	60	20	40	60	0	1	2	3	4	5	6	7	8	9		10	11
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33
34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35

TRADE MARK

ACTAC

T.S.F. 1208 5015

POWERS-BAMAS ACCOUNTING MACHINES

PAID NO. 398223

REC

LABOUR COSTING

NO. 77481

T.S.F. 1208
9015

POWER-BAMAS ACCOUNTING MACHINES

TRADE MARK

FACTORY

LABOUR COSTING

NO. 77481

NO. 77481

NO. 77481

NO. 77481

NO. 77481

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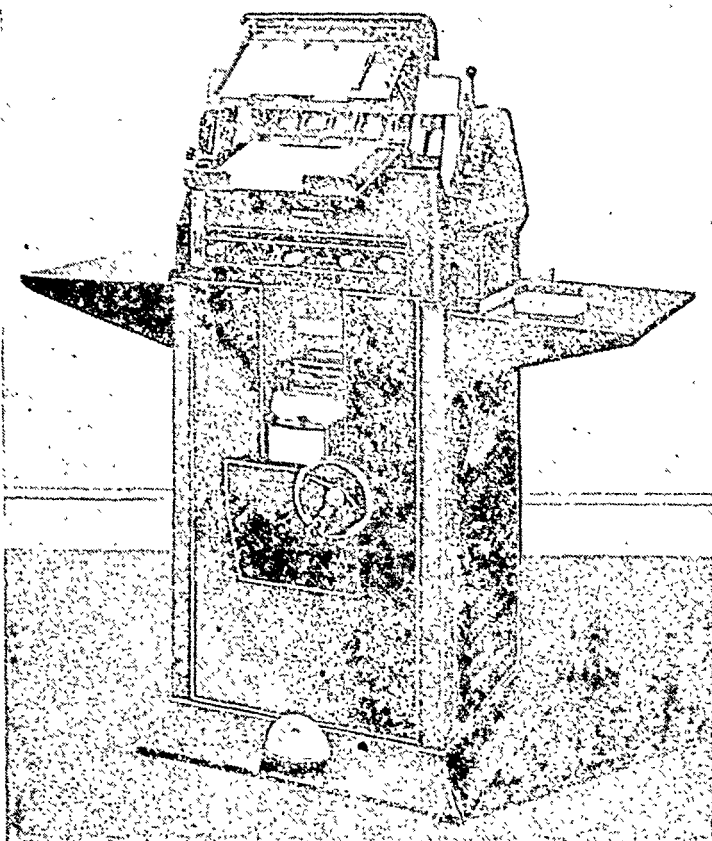


FIG. 165.—Powers-Four Printing Tabulator, and Card Designed for Labour Costing. (Actual size of card.)

Broadly speaking, however, both systems achieve the same results, and with few exceptions the main functions of the individual machines in the two systems are identical.

The Card.—The primary requirement of the Punched-Card System is a card, or number of cards, of standard size and quality, each designed according to the particular accounting or costing purpose for which it is required.

The card used comprises a series of vertical columns each in a definite position and each containing fixed positions for figures 0 to 9 (with one or two additional positions if required). Thus there is a settled number of vertical columns with fixed

FIG. 166.

DEPARTMENT										AMOUNT										EARNINGS										DEDUCTIONS																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
EXPENSES										TOTAL										GROSS										NET																			
422										2 10 9										1 1 1 1 1 1 1 1 1 1										1 1 1 1 1 1 1 1 1 1																			
22										9										2 2 2 2 2 2 2 2 2 2										2 2 2 2 2 2 2 2 2 2																			
Total										7 19 6										3 3 3 3 3 3 3 3 3 3										3 3 3 3 3 3 3 3 3 3																			
Deductions										1 1 1 1 1 1 1 1 1 1										1 1 1 1 1 1 1 1 1 1										1 1 1 1 1 1 1 1 1 1																			
S. H. & L. Tax										1 1 1 1 1 1 1 1 1 1										1 1 1 1 1 1 1 1 1 1										1 1 1 1 1 1 1 1 1 1																			
Social Sec.										1 1 1 1 1 1 1 1 1 1										1 1 1 1 1 1 1 1 1 1										1 1 1 1 1 1 1 1 1 1																			
Federal Fund										1 1 1 1 1 1 1 1 1 1										1 1 1 1 1 1 1 1 1 1										1 1 1 1 1 1 1 1 1 1																			
Total										4 5										7 1 1 1 1 1 1 1 1 1										7 1 1 1 1 1 1 1 1 1																			
N. H. & L. Tax										1 1 1 1 1 1 1 1 1 1										1 1 1 1 1 1 1 1 1 1										1 1 1 1 1 1 1 1 1 1																			

The 80 Column Hollerith Card (reduced).

numerical positions in each, the number of columns ranging from 17 to 130, according to the size of the card, and consequently of the equipment employed.

Each card is made to contain the relevant facts relating to one transaction by the grouping of the columns into "fields", a "field" occupying one or as many columns as are necessary to record the particular fact it contains. The heading of the "field" denotes the nature of the fact recorded therein (e.g. Month, Department, Quantity, Value, Job No., etc.), and the positions of the holes punched in the fields determine the exact information recorded.

Two forms of card are in common use—viz., the single and the dual-purpose card. The single-purpose card is a card punched from original documents solely for machine manipulation and interpretation (Fig. 165), while the dual-purpose card may itself be a document of original entry capable of normal visual interpretation, but at the same time punched—or capable of

being punched—in the appropriate fields for machine manipulation and interpretation (Fig. 166). Such dual-purpose cards are often used as Material Requisitions and Job Cards.

Coding.—Although in many cases alphabetical data are now recorded on punched cards and are tabulated from them on to Invoices, Statements, Pay-rolls, and other documents, it will be apparent that, generally speaking, every fact must be numerically expressed, so that a first essential is the compilation of suitable numerical codes by which, for example, each Workman, Operation, Job, Account, Commodity, Stores Item, and so forth can be identified.

The principle upon which the code is designed depends very largely on the organisation of the individual business and on the information which the accountant requires for the proper presentation of the accounts and statistical records. For example, a code which has been found most useful for Raw Materials by large Engineering Companies is a seven-figure one, divided into three sections, the first two figures indicating material, the third figure indicating shape, and the last four figures indicating size and gauge. A code formulated on the Dewey decimal system is capable of almost unlimited expansion.

Punching.—The perforations in the card are made by means of punches, of which there are two main types, Hand and Automatic. Both types are fitted with a compact keyboard, and the operator depresses, column by column, the appropriate key for the information to be recorded. With the Hand Punch the cards are fed into and extracted from the machine one by one by hand, whereas with the Automatic Key Punches the card feeding and ejection are automatic. The number of cards punched per hour depends on the number of columns being punched in each card, but with Automatic Punches a speed of 12,500 key depressions per hour should be easily maintained by juniors. Punching to represent alphabetical characters is accomplished by a simple system of combination perforations, two per column.

Other types of punch are also available for special purposes. These are :

Reproducing Punch, which automatically punches duplicate sets of cards from existing sets, reproducing the whole or part of the punched information and transposing as required.

Summary Card Punch, which, when connected to the

Tabulator, automatically punches summary or balance cards simultaneously with the printing of the totals or balances by the Tabulator.

Multiplying Punch, which multiplies amounts punched in the cards, and punches the resultant products in any desired position in the same cards. Cross-addition and Cross-subtraction can also be performed with this machine.

In cases where reference is made to the punched card by persons unfamiliar with the system, or in schemes involving the hand extraction of punched cards from a file, it is useful to have the interpretation of the punched information printed on the face of the card. For this purpose an Automatic Interpreter is available which senses the punched cards and prints on them the information punched into them. This machine is speedy in operation, and is often employed in the production of dual-purpose Materials Requisitions or Job Cards, the necessary instructions being interpreted on to the cards from the details pre-punched into them.

There is also a Printing Punch available which punches both alphabetical and numerical data into the cards and simultaneously prints the same information along the top of the card.

Verifying.—As the value of the information produced by the Tabulator from the punched cards depends on the accuracy of the holes punched in them, ample provision is made in the punched-card system for verifying the original punching. Two types of verification are provided, Hand and Automatic.

The Hand Verifier is a machine, similar in appearance and operation to the Hand Punch. The punched card is placed in the Verifier, and the operator, reading from the original document, proceeds as though actually punching. Where there is a divergence between this check-punching operation and the original punching, the machine refuses to function, thus calling attention to the error.

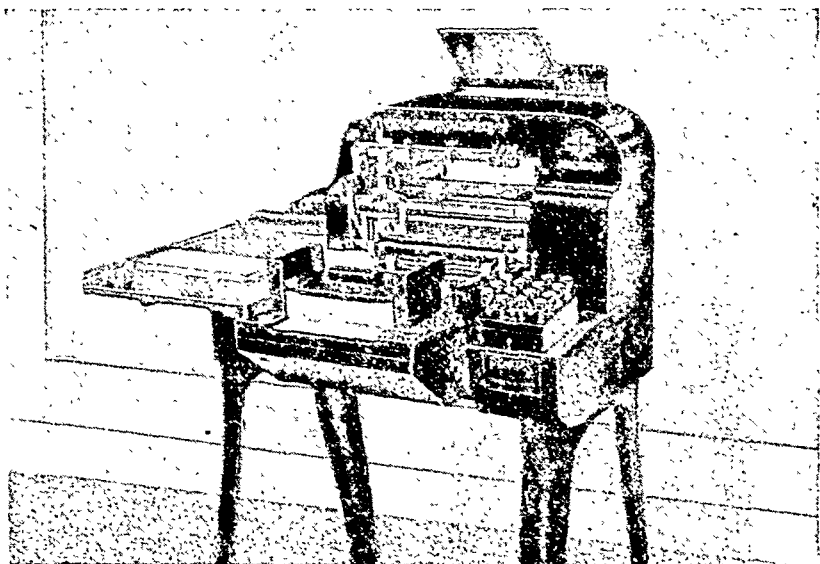
With Automatic Verification, in this second or check-punching operation, the cards are mechanically fed and ejected, and advantage is taken of mechanical sensing to eliminate the human element hazard in the checking procedure.

Sorting.—This covers the procedure of arranging the punched cards in any desired order or classification, such as Man Number, Job Number, Article Number, Nominal Account, etc. It is performed with the Automatic Sorter, which mechanically

groups all cards of similar classification and at the same time arranges such groups in numerical sequence.

The punched cards are placed in the magazine of the Sorter, and a pointer is set against the column on which the sorting process is to take place. The starting button is then pressed, and the machine proceeds to deposit the cards in pockets numbered to correspond with the columnar punching positions, each card naturally falling into the numbered pocket agreeing

FIG. 167.



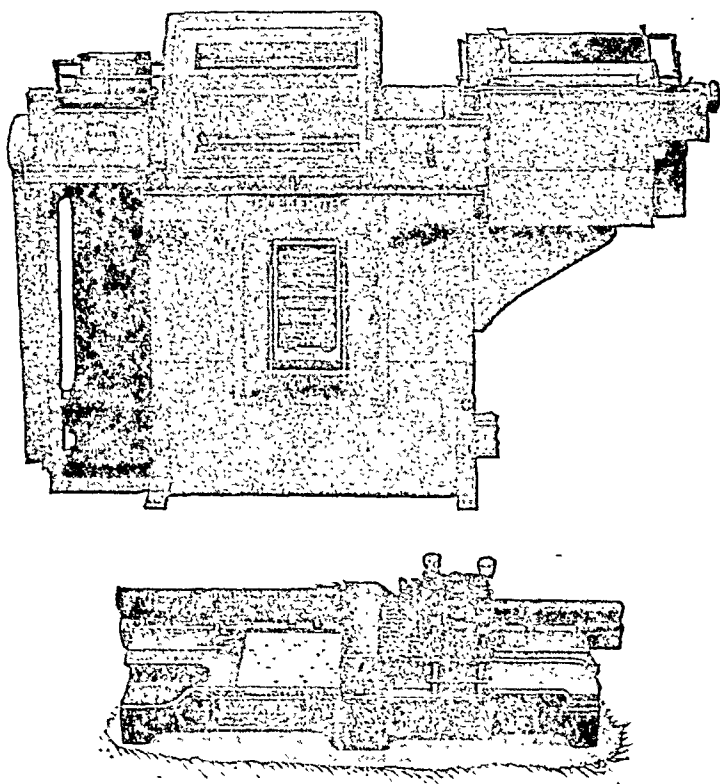
Powers-Samas Automatic Key Punch.

with the position of the hole punched in the column. This operation is repeated column by column for all the columns of the particular field over which sorting is taking place, after which the cards are in strict numerical sequence. The speed of operation, which is entirely automatic, is 24,000 card passages per hour.

For certain sorting work which involves the intermingling of two sets of punched cards (*e.g.* the insertion of cards punched daily for labour or material into a Work-in-Progress file in correct sequence with the preceeding cards for the same job) a machine known as the Collator (Hollerith) or Interpolator (Powers) is available which will, at one simultaneous passage of two sets of

Tabulating.—After the cards have been sorted into the required order they are ready for the Tabulator, which performs the final operation of producing, in clear and legible characters, completed documents in practically any desired form—*e.g.* Cost Summaries, Stock Ledgers, Pay-rolls, Statistical Returns,

FIG. 169.



Hollerith 38-Column Electric Tabulator, and (below) Key-Punch.

etc. This it achieves by reading or sensing the perforations of each card and transferring the information into the adding and printing mechanisms. Each card is read and printed in turn, the adding mechanisms accumulating the individual transactions and giving a printed result of the accumulations as desired; this is known as listing. Alternatively, the machine can be set to print totals only, in which case, the details of each item card included in the totals are omitted.

All the operative columns in the card are sensed simul-

taneously, and there are as many as seven adding mechanisms, besides suitable designating units, which means that up to seven separate additions may be made at the same time. The printing is by means of type through a ribbon, the carriage—in some respects similar to a typewriter carriage—allowing for variations in spacing and the production of carbon copies. Further, a complete line of type—covering, as we have seen, possibly seven sets of figures—is printed at one stroke, as compared with the step-by-step method in manual or other mechanical methods.

Alphabetical transcription from cards, suitably punched, enables names and addresses or other descriptive wording to be printed by the Tabulator in conjunction with the more usual numerical data or additive information.

EXAMINATION QUESTIONS

1. What method of recording work would you recommend for a factory employing over 1000 workers, and how would you propose to deal with the information so recorded, up to the stage of posting the Cost Ledgers? Give an idea of the numbers of transactions at each stage justifying your proposed treatment.—*Royal Society of Arts (Advanced)*.

2. There are various types of machines available for costing. Discuss the relative advantages and disadvantages of different types you know.—*Institute of Municipal Treasurers and Accountants (Final)*.

3. Select a method of recording Overheads by means of punched cards and describe its operation. Discuss what you consider to be the advantages and disadvantages of its adoption.—*Institute of Cost and Works Accountants (Final)*.

CHAPTER XXVII

MECHANISED COST ACCOUNTING (*contd.*)

DESCRIPTION OF THE SYSTEM ADOPTED BY THE PYRENE COMPANY, LTD., USING HOLLERITH TABULATING MACHINES

Introduction.—This chapter describes briefly how tabulating machines, as a matter of routine, can provide, through the medium of punched cards and summaries, the necessary tabulation and recording of information for Costing, Accountancy, Material Control, and Statistics. The Pyrene Company, Limited, the well-known fire and safety engineers, have been pioneers in the application of punched-hole methods to industrial accounting, payment and distribution of the pay-roll, personnel statistics, and material control. Manufacture comprises (1) repetition work, (2) special jobs with repetition element, and (3) wholly specialised jobs. This company has installed Hollerith equipment to meet its essential requirement of obtaining quickly detailed information covering a wide and non-related field of activity.

Some interesting details of the methods employed in the modern and efficient works of the Pyrene Company are given in this chapter.

Description of Product.—Production comprises a variety of products, which, apart from general fire-fighting appliances, include housing supplies, such as heating and plumbing units for modern homes; motor trade accessories; and parkerising, bonderising, and pylumin metal-finishing processes.

The routine caters for fast-moving light-engineering production methods, and has to provide the executives with comprehensive reports, including monthly costs of all products manufactured and other expenditure leading up to a monthly Profit and Loss Account and Balance Sheet. Statistical reports are prepared appertaining to Budgetary Control.

Considerable importance is attached to the efficient usage of materials, both raw and finished parts, to ensure maximum turnover, without carrying excessive stocks, and yet avoid production hold-ups.

(3) Hollerith Requirements Cards No. 314 (Fig. 172) are punched from the Material List results, and then sorted to bring like component parts together.

(4) The Balance Cards No. 305 (Fig. 173) resulting from previous breakdown transactions are merged on the Collating Machine with the Requirement Cards. These Balance Cards represent requirements still unfilled and orders still open, or, if orders have been over-delivered, the Requirements Balance Card would be punched as a credit.

Fig. 170.

Standard Pyrene Extinguisher										3017 Valve Chamber Disc																													
1 175 00 0275		2 ALPH. NATURAL		3 PRODUCT		4 LEAD NO		5 SHEET NO		6 UNABLE DATE NO		7 DCT		8 01																									
01 00				1111		8		4		8769		27.11.46																											
<table border="1"> <thead> <tr> <th>10 100</th> <th>11 100</th> <th>12 100</th> <th>13 100</th> <th>14 100</th> <th>15 100</th> <th>16 100</th> <th>17 100</th> <th>18 100</th> <th>19 100</th> </tr> </thead> <tbody> <tr> <td>14</td> <td>-</td> <td colspan="8">1111</td> </tr> </tbody> </table>										10 100	11 100	12 100	13 100	14 100	15 100	16 100	17 100	18 100	19 100	14	-	1111								<p>MASTER LAYOUT OF MATERIAL CARD</p> <p>DESCRIPTION OF MATERIAL</p>									
10 100	11 100	12 100	13 100	14 100	15 100	16 100	17 100	18 100	19 100																														
14	-	1111																																					
<table border="1"> <thead> <tr> <th>20 100</th> <th>21 100</th> <th>22 100</th> <th>23 100</th> <th>24 100</th> <th>25 100</th> <th>26 100</th> <th>27 100</th> <th>28 100</th> <th>29 100</th> </tr> </thead> <tbody> <tr> <td colspan="2">1111</td> <td colspan="2">2</td> <td colspan="6">1</td> </tr> </tbody> </table>										20 100	21 100	22 100	23 100	24 100	25 100	26 100	27 100	28 100	29 100	1111		2		1															
20 100	21 100	22 100	23 100	24 100	25 100	26 100	27 100	28 100	29 100																														
1111		2		1																																			
<table border="1"> <thead> <tr> <th>30 100</th> <th>31 100</th> <th>32 100</th> <th>33 100</th> <th>34 100</th> <th>35 100</th> <th>36 100</th> <th>37 100</th> <th>38 100</th> <th>39 100</th> </tr> </thead> <tbody> <tr> <td colspan="2">52371</td> <td colspan="2">4</td> <td colspan="6">.28</td> </tr> </tbody> </table>										30 100	31 100	32 100	33 100	34 100	35 100	36 100	37 100	38 100	39 100	52371		4		.28															
30 100	31 100	32 100	33 100	34 100	35 100	36 100	37 100	38 100	39 100																														
52371		4		.28																																			
<table border="1"> <thead> <tr> <th>40 100</th> <th>41 100</th> <th>42 100</th> <th>43 100</th> <th>44 100</th> <th>45 100</th> <th>46 100</th> <th>47 100</th> <th>48 100</th> <th>49 100</th> </tr> </thead> <tbody> <tr> <td colspan="10"></td> </tr> </tbody> </table>										40 100	41 100	42 100	43 100	44 100	45 100	46 100	47 100	48 100	49 100																				
40 100	41 100	42 100	43 100	44 100	45 100	46 100	47 100	48 100	49 100																														

(5) A tabulation of the cards is now produced on Form No. 334 (Fig. 174) showing Balance of Requirements unfilled.

Requirements on current breakdown.

Less Orders still open or over-delivered.

FY 33C-500-46214

TAB. NO.

MATERIAL LIST

NO M 999

DATE 20.3.46

CARD NO. 314

RAW MATERIAL AND COMPONENT PARTS REQUIRED

PRODUCTION ORDER NO

19999

QUANTITY

PRODUCT Standard Pyrene Extinguisher

NO. 1111

SCRAP ALLOWANCE RM 5%
CP 3%

BALANCES REQUIRED AS FOLLOWS—

COMPONENT PARTS										RAW MATERIAL			
ASSEMBLY OF PART DIRECT TO PRODUCT MAIN ASS. SUB-ASS	IDENTITY CODE				NO PER SET	UNIT	REQUIREMENTS (11) OR P (12)	KIND	RAW MATERIAL NO	UNIT	QUANTITY	QUANTITY PER 100 SETS	
	1	2	3	4								DECIMAL	DECIMAL
11111	1	2	55	001			1	00					
11111	1	2	3188	001			1	00					
11111	1	2	33361	001			1	00					
11111	1	2	33374	001			1	00					
11111	1	4	4	001			1	00	51945	4.		12.	0.
11111	1	4	10	003			1	00	57820	6.		15.	
11111	1	4	20	003			1	00	52352	4.		25.	
COMPILED BY										REMARKS			
CONTINUED ON SHEETS NO.										PUNCHED BY		VERIFIED BY	
DATE RECEIVED BY										NO. OF SHEETS			

COMPILED BY	CONTINUED ON SHEETS NO.	PUNCHED BY		REMARKS
		VERIFIED BY		
DATE RECEIVED BY	NO. OF SHEETS			

[illegible]

(10) From the tabulation of Form No. 334 for parts or assemblies to be manufactured Hollerith "Ordered" cards No. 313 are punched.

Requirements Control (Purchased).—Control Ledger Form Nos. 352 and 356 (Fig. 177) are maintained, to which are posted Card No. 314 as debits and Card No. 312 "Delivered" (Fig. 178) as credits.

Fig. 173.

[illegible]

Fig. 174.

P.Y. No. 314-1000

REQUIREMENTS OF MANUFACTURED COMPONENT PARTS

No. _____ 3 DATE _____

TAB No 257

13 PRODUCT _____ 9 PRODUCTION ORDER No _____ 15 RAW MATERIAL No _____ 17 TOTAL QUANTITY _____

AUTHORISED BY _____ Batches Issued List No _____ SCRAP ALLOWANCE _____

14 A.M. or C.P. No.	10 CODE	11 PRODUCTION ORDER No.	12 PRODUCTION No.	13 QUANTITY TO BAKEN ON WOODS	14 C.P. REQUIREMENTS	15 UNIT	16 RAW MATERIAL No.	17 QUANTITY PER 100 SETS OF COMPONENT PARTS	18 DEC.
519	6	10756	2995		23	2455.5	51934	276	4
519	7				24	2475.0			
10025	3				25	4.5	51939	3900	4
10025	7	18756	2941		26	2.5	51939	3900	4
10025	7	18756	2940		27	5.0	51939	3900	4
10025	7	18756	2912		28	5.5	51939	3900	4

[illegible]

Cards No. 312 are then sorted out and used to credit the Order Control.

PT REQUIREMENTS		RAW MATERIAL		REQUIREMENTS						RECORD CARD		REQUIREMENTS		CASE NO.
ITEM NO.	DESCRIPTION	QTY	UNIT	YEAR	STOCK CLASS	DATE	APPLIANCE USED ON	QTY REQD	PERIOD	AM STOCK NO.				
1	Buss Bar, 1/4 dia.	4	LB	1945	S	7	Pt P-1 Protec Exts. Junior			52022				
2				1946	A	1	Protec Exts. P.O.H.44 P.O.H.77	8						
3				194			Switch Case Auto.Switch							
ITEM NO.	DESCRIPTION	QTY	UNIT	PRODUCTION ORDER NO.	DATE DATE/MONTH	S.R.K. NO. OR BATCH NO.	REQUIREMENTS	QTY	17 REQUISITIONED AND BALANCE	REMARKS				
2	52022							4	2202					
22	52022							4	33					
22A	52022	187.05	8902	36324855.8				4	1200					
22B	52022	187.27	1502	33.9				4	16					
22C	52022	605.14	2902	32.7				4						
22D	52022	187.27	1502				205	4	1165					

PY312		ACCOUNTS PAYABLE AND PURCHASE STATISTICS CARD																											
FIRM NAME		FIRM ADDRESS		FIRM CITY		FIRM STATE		FIRM ZIP		FIRM PHONE		FIRM FAX		FIRM TELETYPE		FIRM RADIO		FIRM TELEVISION		FIRM CABLE		FIRM MAIL		FIRM AIR		FIRM SEA		FIRM SPACE	
FIRM NAME		FIRM ADDRESS		FIRM CITY		FIRM STATE		FIRM ZIP		FIRM PHONE		FIRM FAX		FIRM TELETYPE		FIRM RADIO		FIRM TELEVISION		FIRM CABLE		FIRM MAIL		FIRM AIR		FIRM SEA		FIRM SPACE	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	2	3	4	5	6	7	8	9	10	11	12																		

FIG. 179.

[illegible]

Requirements Control (Manufactured) Form Nos. 352 and 356.—The same procedure is followed as for the Purchase control, but in this case the credits are obtained from Card No. 304 (Fig. 180), covering deliveries to Store of manufactured parts and assemblies. These are again used to credit Order Control.

Adjustments.—Cases arise where a requirement has been delivered short and the order closed, and it is decided to cancel the balance. An Adjustment Credit Card No. 313 is then punched, indicating in Col. 67 that it is an adjustment, and not goods received. This is then included in the normal posting operation. All other adjustments are covered in the same manner, such as parts or productive material used on plant maintenance, etc., which become debits as the production requirement has still to be satisfied. Over-deliveries do not need an Adjustment Card, as the effect of these is to reduce the requirement total when next scheduling.

Order Control (Purchased). Form Nos. 351 and 355. (Fig. 181).—Cards No. 313 (Debit) and No. 312 (Credit) are posted in the same manner as Requirements Control, the latter being the same cards as were used for the Requirements Credits (Purchased).

Order Control (Manufactured). Form Nos. 351 and 355.—Cards No. 313 (Debit) and No. 304 (Credit) are posted, the latter again being the same cards as were used for Requirement Credits (Manufactured).

Completed Orders (Manufactured).—When notification is received that an order has been completed Hollerith Card No. 304 is punched, on which is indicated that it is a final delivery. At the end of each month they are passed through the Collating Machine, together with the detail file of cards which have been posted to the Order Control, and all cards relating to completed orders are automatically abstracted from the file.

Goods Inwards (Purchased).—When received, goods are inspected for quality and passed to Receiving Department, where they are checked for quantity against the purchase order and the Goods Received Note Form No. 500 originated. The Receiving Department hold a copy of the Purchase Orders, which have recorded on them the description of the material ordered and its appropriate code numbers, identifying the material—i.e. Stock Number and the nominal account chargeable. These are entered on the Goods Received Note, and by this method subsequent coding is obviated, and the Note can be sent direct to the Voucher Department.

The Voucher Department match up the Goods Received Note with the appropriate Purchase Invoice when received, certify the invoice prices and calculations, and transfer the amounts to the Goods Received Note, which then becomes a completed document, and is the medium for punching Hollerith Card No. 312.

All Purchase Invoices are registered daily, and a control total established. The relative Hollerith Cards are tabulated and agreed with this control total.

At the end of each fiscal month all transactions are dealt with in the following order :

(1) The Cards No. 312 are sorted to Stock Number and posted to the Stock Record cards. Form No. 350A for Raw Material (Fig. 182) and Form No. 334 for Component Parts.

(2) The cards are re-sorted to Nominal Account Number and listed, which forms the posting medium for the journal.

(3) Cards are again re-sorted to Supplier Number, and posted to the Purchase Ledgers Form No. 366 (Fig. 183).

It will be appreciated that complete accuracy is assured in all sections, as the same cards are used in each case and the total obtained at each stage agreed with the original controls.

A Remittance Form No. 213B (Fig. 184) for preparing cheques for payment of suppliers' accounts is prepared by abstracting all outstanding items from the detail file of cards from which the Ledgers have been posted.

From the Cash Paid list, which is a duplicate of the cheques drawn, Hollerith Cash and Discount Cards No. 319 (Fig. 185) are punched, and these form the medium for abstracting all paid item cards from the Ledger file, leaving only outstanding cards in the file ready for compiling the next remittance list.

Goods Inwards (Manufactured).—As already indicated, Stock Record Cards are posted for all purchased material and parts from Hollerith Card No. 312 originated from the Goods Received Notes. The parts manufactured are recorded on Hollerith Card No. 304, with similar information to that given on the Goods Received Note for purchased items.

Material Routing.—From the Material Breakdown Schedule sets of documents are prepared in the Adrema Addressing Machine Section, where plates are maintained covering all essential data, relative to each Component Part. The set contains the Material Requisition and Delivery to Store Cards, Labour Cards for each operation, Departmental Transfers, etc., and Works Order.

BOOK		RECORD CARD		FANS NO 308		HM STOCK	
100-01		Protex Ext. P.O.N.44 P.O.N.47 //		100-01		100-01	
Switch Cino Auto Switch		QUANTITY		UNIT		VALUE	
AVERAGE PRICE PER 100		QUANTITY		UNIT		VALUE	
52	375500	1	114.15	5			
12	100.00	1	5.10	708			
12	206.00	1	6.708				
12	120.00	1	3.15	508			

ORDER LIMIT		MINIMUM QUANTITY		SCHEDULE	
DATE	QUANTITY	DATE	QUANTITY	YES	NO

Fig. 183.

ACCOUNTS PAYABLE							SUPPLIER NO.
P&L A/C	SUPPLIER	REF. NO.	DATE DAY MTH	ITEMS	DEBIT-	CREDIT	BALANCE
1780000178			25	08			
1780000178		558	10	05	250. 0. 0	14. 16. 8	
1780000178		1409	28	05		41. 13. 4	
1780000178		1421	19	06		10. 0. 0	
1780000178		1504	02	03		28. 3. 4	
<div style="display: flex; justify-content: space-between;"> <div> <p>KEY TO ABBREVIATIONS</p> <p>GDS. GOODS</p> <p>CSH. CASH</p> <p>DIS. DISCOUNT</p> <p>CAR. CARRIAGE</p> <p>CR. CREDIT NOTE</p> </div> <div> <p>TFR. TRANSFER</p> <p>CON. CONTRA</p> <p>RFD. REFUND</p> <p>SDY. SUNDRIES</p> </div> </div>							
<p>PY 368-5.000 46203</p>							ACCOUNTS PAYABLE

THE PYRENE COMPANY LIMITED

GREAT WEST ROAD, BRENTFORD, MIDDLESEX

TELEPHONE:
EALING 3444 (4 LINES)
TELEGRAMS:
"PYRENE," BRENTFORD

DATE



Payable and due to the company of the account in accordance with the undermentioned particulars
PAYEE COMPANY THE TOWN OF EIGHT OF CHOUT WHICH IS THE ONLY ACHOWNDOWMENT REQUIRED

No. of Invoice	Date of Invoice	Particulars	For	£	s	d	Balance
2612	3105	26	04	45	05		1. 11. 2
2612	3106	27	04	45	05		13. 0
2612	3273	16	05	45	05		59. 12. 0
2612	3246	24	05	45	05		1. 5. 6
2612	3247	22	05	45	05		4. 1. 3
2612	3240	17	05	45	05		24. 16. 5
2612	3240	17	05	45	05		24. 16. 5

PAID FOR PAYMENT

SET TO APPROPRIATIONS

GDC G-215
 CDM C-215
 DIS C-215
 CASH CASH
 CREDIT NOTE
 PAY CREDITORS

THE AMOUNT IN THE LAST COLUMN IS THE
BALANCE DUE ACCORDING TO OUR BOOKS

When the order is ready to enter the production cycle, the shop clerks release the pre-written requisitions, and the Store-room delivers the material identified by an accompanying tag to the shop, while at the same time the storeroom clerk records the transaction in quantity only on the Works Order and also on the Bin Card, which shows a continuous balance.

The requisition Cards No. 304 are then passed straight to the Tabulating Department, where they are punched, with the exception of the price and value, these being carried out automatically by collating the closing Balance Cards (which contain the unit price) with Card No. 304, after which they are passed

Fig. 185.

ACCOUNTS PAYABLE										ACCOUNTS PAYABLE									
"HOLLERITH" 4-10350-0-61 PY 510										ACCOUNTS PAYABLE									
DATE										DATE									
MONTH										MONTH									
YEAR										YEAR									
SUPPLIER NO.										SUPPLIER NO.									
AMOUNT										AMOUNT									
1										1									
2										2									
3										3									
4										4									
5										5									
6										6									
7										7									
8										8									
9										9									
0										0									
1										1									
2										2									
3										3									
4										4									
5										5									
6										6									
7										7									
8										8									
9										9									
0										0									

through the multiplying punch, utilising the Balance Cards as group multipliers, and each requisition is then automatically extended, and the result punched into the requisition itself. By this method hand pricing, extensions, and hand-punching operations are eliminated.

The Material Requisition Cards, together with any Delivered-to-Store Cards, are then listed and sectional totals produced. This list serves as a pulling list for the Stock Record or Ledger Cards and the appropriate cards are pulled from the file, and the Stock Records posted, the posting for each section being accumulated and agreed with the Controls.

Balance Cards are automatically punched as the posting of each Stock Record Card is completed. New average unit prices are computed and recorded in the appropriate column on the Stock Record, and punched into the new Balance Cards.

The old Balance Cards are sorted out, and the Detail Cards

are filed in the Cost Work-in-Progress File, pending compilation of the costing of completed orders.

A regular check is maintained between the balance quantities on the Stock Record Cards and the Bin Cards; all balances being verified each month.

Labour Distribution.—The Labour Cards or Time Tickets No. 301 (Fig. 186) prepared by the Addressing Machine Section contain all the essential data for each order and operation. Piecework is based on hours per 100, with the addition of the usual overtime and cost-of-living awards. The cards are sent to the shop clerks, with the order set, who issue them to the operators when called for by the Production Departments. The actual times worked and quantities produced are recorded by the shop clerks, and are also entered on the Works Order, which contains provision for recording the result of each operation and transfers from department to department. Each day Labour Cards as completed are sent to the Pay-Roll Department, where the quantity goods produced is multiplied by the basic hours per 100 on Comptometers, and the result entered in the earned hours panel of the card. These are the original cards, and are identified as such by punching "00" in the allowance field. The cards are fully punched, with the exception of the Amount or Wages field. For Time Workers, the Hours Worked field is punched and the hours earned which do not apply is left blank.

The codes for allowances in field 20 are as follows :

[illegible]

The Day-work Cards are tabulated and checked for hours worked against the Clock Cards.

All Hollerith labour and material cards are then sorted to Order Number and collated with the punched cards forming the Order Record file, showing the open orders on hand. This has

[illegible]

the effect of ejecting any errors made by the shop clerks in recording Order Numbers. These are listed and the list sent to the shop clerks for correction, after which revised cards are punched to take care of the corrections.

The following tabulations are produced weekly; in some cases all cards being operated, and in others only those cards applicable to the subject :

Analysis by Labour Division and Department.

Operation analysis for Rate-fixing Department (comparing hours earned with hours worked).

Machine Activity.

Defective Work.

Labour cost of rectifying defectives.

Overhead.—Overhead is dealt with at the end of each month, when all Productive Labour Cards are tabulated by Department and Order Number and overhead is calculated, and recorded on this tabulation from which special overhead cards are punched.

Summaries.—Finally, the Labour, Material, and Overhead Punched Cards previously described are sorted monthly to Order Number and operation and tabulated to automatically produce Summary Cards on the punch attached to the tabulator. The

Fig. 188.

[illegible]

Fig. 189.

[illegible]

CHAPTER XXVIII

MECHANISED COST ACCOUNTING (*continued*)

PRODUCTION CONTROL AND COSTING IN THE ENGINEERING INDUSTRY

SYSTEM USING POWERS MACHINES

THE methods described in this chapter are those employed by The Plessey Co., Ltd., the well-known Electrical and Mechanical Engineers, and are furnished with the kind permission and assistance of Mr. E. H. Ousten, Chief Accountant to the Company, and Mr. V. M. Kelvie, Mechanisation Officer.

The system is operated with Powers 65 column equipment, but the company has also Powers 36 column equipment for certain of the work, which by this means is more economically handled. This is in accordance with the policy pursued throughout the organisation of endeavouring to achieve maximum efficiency by fitting the equipment to the job, rather than the job to the equipment.

PRODUCTION CONTROL

At the outset it should be noted that the company make full use of Standard Costs. The same data is required for Production Control, and it has been found possible to use the same basic information punched into the Standard Cost cards for reproducing into cards for production control purposes. Four other features to be noted are :

(1) The output of the machining sections is designed to afford a steady flow of parts to the Sub-Assembly and Final Assembly Sections.

(2) Stores Requisitions for Assembly Manufacture, in their generally accepted form, are non-existent, their place being taken by tabulations prepared from the Powers Master card.

(3) A very efficient Perpetual Inventory Department maintains a continuous check on all Materials and Part Stores.

(4) Dual-purpose cards are used throughout the system.

Piece Part Records.—When it is decided that parts shall go into production at some future specified time, the Planning and

Time Study departments prepare a Lay-Out Sheet in respect of each item, a copy of this being received by the Standard Costs department. All Lay-Out Sheets stipulate the manufacture of parts in terms of 1,000 pieces.

From this document a set of dual-purpose cards is prepared by the Standard Costs Department, one blue card (Fig. 190) for the Material to be used and one manilla card for each operation called for.

The cards then pass to the Powers Department, where, after routine punching, verification, and interpreting, they are sorted into Part Number sequence and tabulated to show operations

Fig. 190.

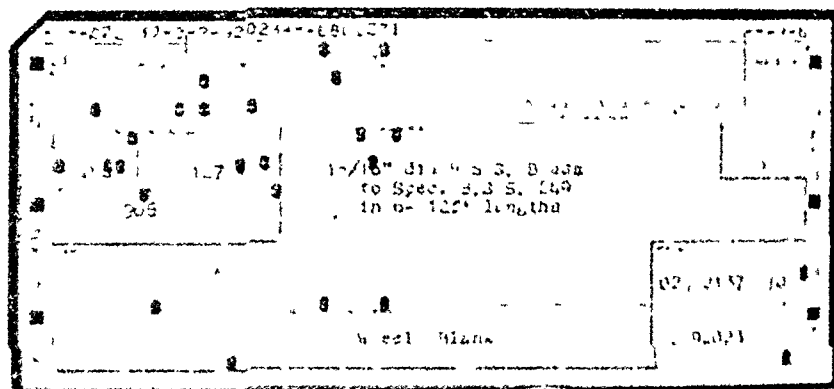


FIG. 191.

[illegible]

“ Standard ” Master Card.

for, and reproduce from them a set of brown cards (Fig. 192), into which is simultaneously gang-punched the Assembly Number and Unit Requirements. The Master cards are returned to the file, and the Parts Lists are returned to the Drawing Office. The Standard Costs Department at the same time will have supplied, as per Lay-Out Sheet in their possession, yellow dual-purpose cards in respect of Assembly Labour, incorporating the floor-to-floor time, standard labour cost, and overhead cost.

From the above-mentioned reproduced cards and Assembly Labour cards, a Standard Cost Sheet (Fig. 193) prepared as for Piece-parts is forwarded to the Standard Costs Department, who

FIG. 192.

[illegible]

"Standard" Assembly Card.

again prepare and supply a Master card for that Assembly or Sub-Assembly.

Production Programme.—The Production Controller raises a Final Assembly programme on the basis of delivery promises made when orders were accepted. This Final Assembly programme quotes the Assembly to be manufactured, the Contract Number, the quantity to be delivered, and the delivery date.

A copy of this programme is forwarded to the Powers Department, who pull from the file the brown cards corresponding to that programme, and reproduce from them a set of manilla cards representing assemblies called for. The Contract number and the quantity to be produced are gang punched into these cards by the Reproducer, and they are then interpreted.

The reproduced cards are then passed through the Multiplying Punch, which calculates the total requirements per Sub-Assembly or Piece-part and punches the result in the "quantity" field. The cards are then listed to produce the Final Assembly Requirements List, which is passed to the Sub-Assembly Storekeeper, as his authority to pre-select and issue the Sub-Assemblies and parts on the Final Assembly Lines. Having indicated thereon the date of issue, he returns the tabulated list to the Production Planning Department.

These cards are then sorted to separate Sub-Assembly and Piece-parts, and one tabulation of Piece-parts and two tabulations of Sub-Assembly Requirements prepared. The Tabulation of Piece-parts is forwarded to the Sub-Assembly Storekeeper for pre-selecting from Piece-part stores for issue on Floor-Assembly Programme.

From a copy of the Sub-Assembly Requirements the corresponding cards are pulled from the Master Sub-Assembly file, a set of cards prepared in the same manner as for Final Assembly Requirements, and a listing completed (again in sequence) of the Sub-Assembly Requirements. This list is supplied to the Piece-part Stores for a pre-selection on to the Sub-Assembly lines. The Sub-Assembly Requirements tabulation is passed to the Assembly Storekeeper for recording receipts from the Sub-Assembly lines and notification of total sub-assemblies required as per pre-selection.

The same procedure of sorting, tabulating, and reproducing is adopted for Sub-Sub-Assemblies until there only remains Piece-parts.

The cards for Piece-parts are then sorted into Part Number

sequence, the parts to be manufactured and parts to be purchased being separated. A tabulation, in duplicate, is prepared from the cards representing parts to be manufactured. One copy is used by the Piece-part Storekeeper for recording receipts into Stores of parts manufactured by the Machine Shop. The second is used by the Machine Shop Progress as the Piece-part manufacturing programme. A tabulation of the cards representing purchased items is then prepared for use by the Piece-part Storekeeper to pre-select purchased parts from stock.

Before passing the lists to the shops, the corresponding Raw Material cards are pulled from the file, and a card reproduced

FIG. 194.

0127

12-13-37

397752

ment, who punch "Excess Material" cards where necessary and file them in Material Code order in a container, pending their use in connection with the monthly Bulk Purchase Requisition on the Buying Department.

Meanwhile the Machine Shop Progress use the tabulation as a "Works Order List" and loads the machines on the sections in accordance with the stipulated delivery target.

On receipt and issue of items, at the various stages of manufacture, indication is made in the appropriate field on the relevant tabulation, which is then initialled and returned to the Production Planning Department as a signal that all operational requirements have, in fact, been carried out.

At the end of each month the "Purchased Parts" cards, together with the "Raw Material Demand" cards, are sorted and tabulated in Material Stock Number order to provide the Purchasing Department with a Composite Purchase Requisition for ordering or calling up against forward contracts.

Changes in Standards.—Where a change in Material usage arises, the Planning Department notify the Powers Department immediately. On receipt of such notification the latter take steps to prepare a new "Signal" card or cards covering the change.

For Production Control the change becomes effective immediately (or at date stated). For the Standard Costs Department a revised Standard Cost Sheet is prepared in a distinctive colour, which is used for Commercial quotation purposes until the end of the current "Standards" period.

COSTING

Labour—Direct.—Each Production Department originates dual-purpose production dockets (Fig. 195) with two flimsy copies—one coloured and one white—for the operation or group of operations for which it is responsible. These cards are prepared when the work is about to be commenced, and in the case of standard lines the following information is pre-printed by means of an Adrema machine: department, part number, description of part, description of operation, standard machine group and routing instructions, and the Progress clerk fills in the release note number, specification number, cast number, batch quantity, and works order. As each job is commenced the shop clerk enters

the date, operator's name, clock number, quantity required per hour, and time started.

The plant number indicates the machines on which the work is actually to be performed. The shop clerk is therefore able to compare the standard machine specified for the operation with the plant number he enters on the docket. If the two do not agree, the matter is immediately brought to the notice of the time-study engineer, who, where necessary, authorises the allowance of an appropriate amount of excess time, for crediting the operator's piece-work earnings. A code indicating the type of excess is

FIG. 193.

11 22 24543 54

10 18 1012

329

3 2.6.35

33 43

1164

15 2 X277

TO: P.C.M.

TO: Still 102-5

Still 71.

Direct Labour Card.

instruction and to provide the necessary information (works order number, etc.) for booking in the job by the next department, but the Powers Card and the white flimsy are passed to the Shop Clerical (Piece Work) Section, who calculate and enter on them the actual hours, excess hours (*i.e.* quantity multiplied by time-study allowance), and earned hours (actual plus excess hours). The cards are then passed to the Powers Department for punching and checking. The white flimsies are filed in operator sequence until the week-end, when, having served as a check on the hours recorded, they are handed to the operator prior to pay-day to enable him to verify his bonus.

FIG. 196.

-70-364-70		70540		0043		-43	
DATE	DEPT.	EXP. NO.	CLOCK NO.	NAME	OPERATOR'S RATE	DESCRIPTION OF EXPENSE	
30/73	70	364/70	70/540	Jennings			
10.5	11.0	49.5	3	3	3	Tool Repairs	

Indirect Labour Card.

Labour—Indirect.—An “Indirect” dual-purpose card (Fig. 196) is made out for all indirect labour (*i.e.* waiting time, supervising, cleaning, etc.), the information recorded being date, department, expense number, clock number, name, operator's rate, and description of expense. The actual hours and cost are entered by the Shop Clerical Section on the Powers Cards, which are then passed to the Powers Department for punching and checking, whilst the white flimsies are retained for completing the operator's record of hours worked.

Tool-making.—Tool-making forms an important section of the company's activities. Actual costs for all tools are collected and compared with detailed tool estimates. Special dual-purpose cards with flimsies (Fig. 197) are used for recording the labour times and class of machine or bench work for each operation. These cards are originated when the Tool Lay-Out Sheet

is prepared and go to the Tool Progress clerk. When the job is booked "on" the operator takes the flimsy, but the card is retained by the shop clerk. The flimsy then accompanies the work to inspection at the end of each stage, after which the set of dockets for the next operation accompany the work and the flimsy is returned to the shop clerk and forms the signal for the release of the Powers Card to the Powers Department for punching and checking. The flimsy is retained by the shop clerk for the weekly check of hours against the clock record.

After the various types of labour cards have been punched and verified they are retained until the end of the week, when various tabulations are prepared.

FIG. 197.

The image shows a 'Toolmaking Card' with handwritten entries. The card is divided into several sections. At the top left, 'Job No.' is written as '33'. To its right, 'Description' is written as 'T156.6'. Further right, 'Teller' is written. Below these, there are several lines of handwritten text, including 'B 5' and '70'. The bottom section of the card is a table with three columns. The first column is labeled '25'00', the second '105 25', and the third '3 0'. The table contains several rows of handwritten data, including '25'00', '105 25', and '3 0'.

Toolmaking Card.

OPERATOR'S PIECEWORK ANALYSIS

ORDER NO.	PART NO.	QTY/H	DEPT/CLOCK NO.	PLANT NO.	QUANTITY GOOD	QUANTITY REJECT	QUANTITY SCRAP	ACTUAL HOURS	ALLOWED HOURS
223463	13003	2	1	18030	438			20.	3
223463	13009	1	1	18030	190			7	10
223463	13009	1	1	18030	539			20.	3
223463	13009	2	1	18030	523			17	4
223463	13009	2	1	18030	488			20	2
223463	13009	2	1	18030	137			5	8
223463	13009	2	1	18030	204			10.	1
223463	13009	2	1	18030	818			16.	12
223463	13009	2	1	18030	229			6	12
					3566			117.	137.
27378	60442	2	1	18030	344			85	107.
27378	60442	2	1	18030	52			40.	37.
21077	91386	4	1	18030	178			25	75
21077	91386	4	1	18030	194			40.	82.
10014	49269	1	1	18030	229			28	50
					997			238	321.
150870	91109	1	1	5265	330			15	33
150870	91109	1	1	5265	501			33	502.
150870	91109	1	1	5265	100			7	12.
574832	13033	105	1	5265	291			18.	31.
564073				26070	233			10.	10
564073								70.	70
								78.	78
								45	45
					1455			276.	329.
223863	28604	15	15	30341	1243			20.	24.
223863	28604	15	15	30341	313			52	8.
149038	49066	22	22	30363	796			12	16.
149038	49066	22	22	30363	284			32	71.
149038	49066	22	22	30363	22			22	23.
511070		1	1	26041	041			1	1
513070		1	1	30341				5	5
513070		1	1	30363				5	5
513070		1	1		3569			185	198.

Production and Efficiency Analysis.—An important tabulation is prepared weekly showing the shop efficiency on various types of piecework analysed over machine, bench, and assembly. This is obtained by sorting the Direct Labour Cards on column 63 in which has been punched the piecework code and also over columns 31–35 (Plant Number), and 12–19 (Part Number). A copy of this tabulation is passed to the time-study engineers for information, which throws up, for example, the amount of time lost through having to perform an operation on an alternative machine which is possibly slower and therefore more expensive.

Expense Analysis.—Indirect Labour Cards are sorted by expense and department and then tabulated to provide total weekly expenses under each expense code. Simultaneously with this tabulation, the Summary Card Punch produces summary cards which are used for tabulating the indirect wages charges at the end of the month for posting to the appropriate nominal accounts and also for making the necessary inter-departmental transfers of such charges.

provided by their punched card equipment, which in addition is also used for their Sales and Purchases Accounting and Sales and Order Statistics.

EXAMINATION QUESTIONS

1. Draw up a ruling for a Stores Received and Stores Issued Record—*Institute of Cost and Works Accountants (Inter.)*.

2. Prepare a specimen Stores Requisition or withdrawal note and trace its progress through the organisation up to its final filing. How would you ensure that all requisitions reach the Cost Department?—*Association of Certified and Corporate Accountants (Final)*.

CHAPTER XXIX

GRAPHIC PRESENTATION OF FACTS. STATISTICS, AND BUDGETS

I. GRAPHS AND CHARTS

The Utility of Charts.—Figures presented in columns, tables, or series are difficult to visualise. Points of importance, especially as to the relationships of sets of figures, are easily overlooked. If the same facts are presented graphically, a clearer mental picture of the figures is secured at once. The relative importance of varying magnitudes is revealed without mental effort.

To the cost accountant and factory manager the graphic chart represents useful facts at a glance, such as production costs, movement of expenses, units of output, the position and movement of stocks, facts about labour, wages, and volume of production. Sometimes the charts do more, in that the trend or tendency of facts and events is often indicated, assuming that conditions continue as ascertained and represented on the charts.

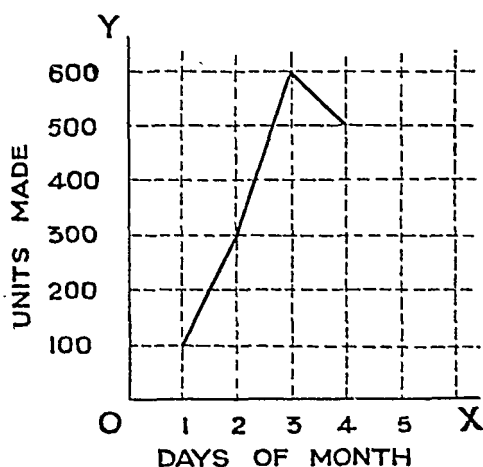
The Functions of Graphic Charts,* from the points of view of the management of industrial undertakings, are :

Line Charts.—These are commonly prepared on paper ruled into squares by intersecting horizontal and vertical lines, usually in multiples of ten.

If two lines OY and OX are drawn, as shown in Fig. 199, on squared paper, the point of intersection O is called the *origin*; the base line OX , the *abscissa*; and the line OY , the *ordinate*.

If the daily output of articles for the first four days of the month were (1) 100; (2) 300; (3) 600; (4) 500, these facts can be plotted on squared paper, as in Fig. 199. By using each square on the abscissa as a day, and each one on the ordinate as 100 units, a vertical line drawn from each point on the base line will

FIG. 199.



intersect a horizontal line drawn from each point on the ordinate. If now a line is drawn connecting each point of intersection, this portrays how the units made have varied in number each day. The connecting line is called a plotted graph, or curve. The graph shows at once whether the quantity made is increasing, decreasing, or stationary. This is the most usual method of presenting data in graph form.

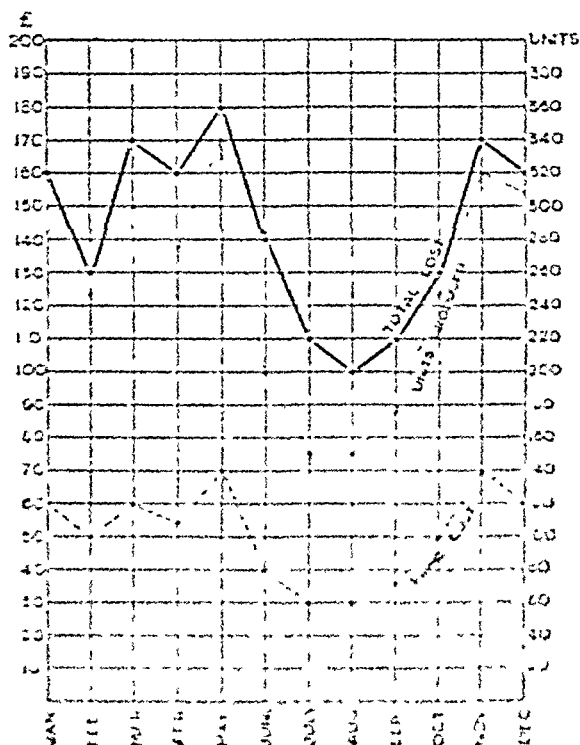
Using the Line Chart.—As the squares on the chart are all equal in size, all similar increases, or decreases, in figures plotted are represented by the same vertical distance on it. If, therefore, two or more comparable sets of figures are plotted on squared paper, the vertical rise and fall of the curve indicates the magnitude of each series plotted in terms of actual quantities.

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Example : The following figures are shown in the form of a line chart, in Fig. 200.

Date.	Units Produced.	Total Cost.	Prime Cost.
January	300	£ 160	£ 60
February	250	130	50
March	300	170	60
April	275	160	55
May	340	180	70
June	200	140	40
July	150	110	30
August	150	100	30
September	175	110	35
October	250	130	50
November	325	170	70
December	310	160	60

FIG. 200.



- (3) Labour-hours worked and total wages paid.
- (4) Departmental allocation of overhead and recoveries made on jobs.
- (5) Comparison between cost of direct labour, materials used, and standing charges.
- (6) Output of two or more similar shops or machines.
- (7) Production output for two comparable periods.
- (8) Actual overhead expense and budgeted expense.
- (9) Production or cost for present period compared with moving average.

When several curves are used on the same chart to show data of the same nature, but for diverse periods, lines of distinctive colours, or types, may be used. Too many lines on one chart interfere with legibility, and should be avoided. The base line should always be zero, otherwise a false view may be given. The method described above is the *natural scale method*.

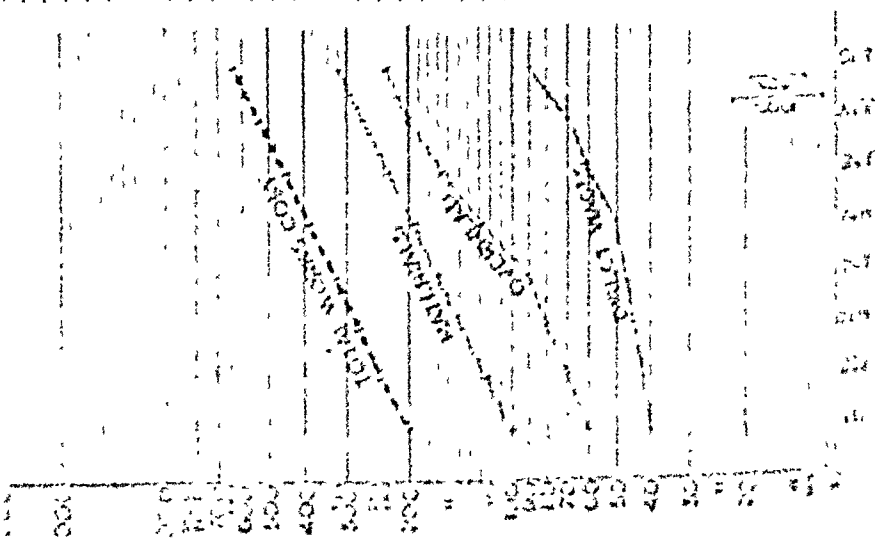
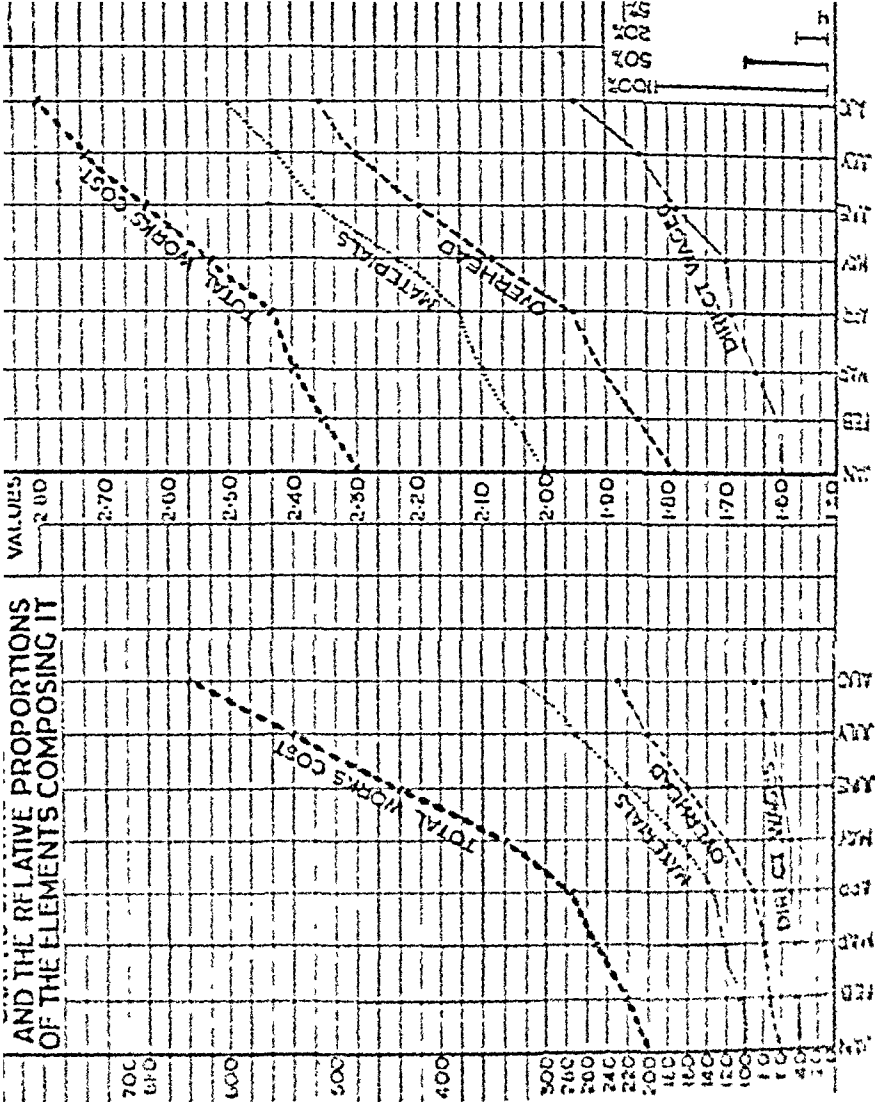
The Disadvantage of the Natural Scale Method.—A rise, or fall, of equal magnitude is represented by the same vertical distance on the chart, *e.g.* Units produced: 2000 last month, and 3000 this month—increase 1000 units; but assume that the output figures were 50,000 and 51,000—also an increase of 1000 units. Then, in both cases, the graph would show exactly the same rise in the curve, yet, in the first, the increase was 50 per cent., and, in the second, only 2 per cent. Such curves are likely to be deceptive when attempting to consider the *ratio* of rise or fall. The difficulty is overcome by using a special ratio ruling, or by plotting the figures on a logarithmic scale. Such charts are sometimes called *Logarithmic Historigrams*.

Ratio Ruling or Logarithmic Scale Graphs.—To show percentage variations, it is necessary either

- (a) To use ratio ruling, or,
- (b) To use logarithms of the actual numbers on semi-logarithmic charts.

For the latter method, the logarithms of the numbers are plotted on the chart, and this has the effect of plotting *ratios* of rise and fall; *not* the rises and falls themselves. If the latter are desired, they may be shown by figures inserted on the right-hand side of the squared paper, but these are not plotted on the chart.

AND THE RELATIVE PROPORTIONS OF THE ELEMENTS COMPOSING IT



In Fig. 201, the centre graph shows curves plotted on ordinary squared paper, representing actual figures. The right-hand graph shows the same curves plotted on square paper using a logarithmic scale, *i.e.* using logs of the numbers, thus representing ratios. The left-hand graph shows the same curve plotted on ratio ruled, or semilogarithmic paper. In the left- and right-hand graphs, the same vertical distance between any two points represents an equal percentage difference on *any* part of the graphs.

It is not necessary or even desirable for the base line to be zero in using the Logarithmic Scale, but it is essential for the Natural Scale previously described. The same ratio exists at any portion of the scale on the graph. This advantage is not secured when the Natural Scale is used.

Ratio Ruling.—The horizontal lines are ruled in a manner which represents multiplication, instead of addition, as in the natural scale ruling. Thus, the same distance between lines is used to represent a rise from 2 to 3, as from 4 to 6, 6 to 9, 60 to 90. In other words, a graph curve shows a *proportionate* increase, or decrease, in the figures plotted, instead of the actual differences.

Two parallel lines plotted in a ratio chart indicate that the two series of figures plotted are increasing, or decreasing, in the same ratio. It is important to remember that where absolute figures and variations, as distinct from relative variations, are to be charted, the natural scale rectilinear chart is required.

Progress Charts.—There are two useful methods of graphically showing progress of work, etc. :

(a) Prepare a natural scale graph of the scheduled quantities in a stated time, and then plot the actual quantities, as the work proceeds.

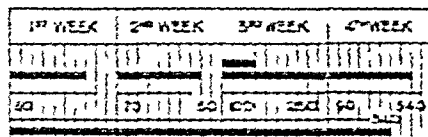
(b) By using horizontal "bars." The scheduled work is represented by a horizontal line, with quantities budgeted for at each point of time. As the work proceeds, another bar, drawn thicker or in another colour, is run parallel to the scheduled bar. If quantities produced are less than those scheduled, the line will fall short of the line representing scheduled quantities. When the weekly (or daily) schedule is exceeded, the excess is drawn above, as in the third week in Fig. 202.

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Example : A Progress Chart of the following facts is shown in Fig. 202.

	Scheduled.	Completed.
1st week	80 Units	70 Units
2nd "	70 "	80 "
3rd "	100 "	130 "
4th "	90 "	80 "
Total	340 Units	360 Units

FIG. 202.



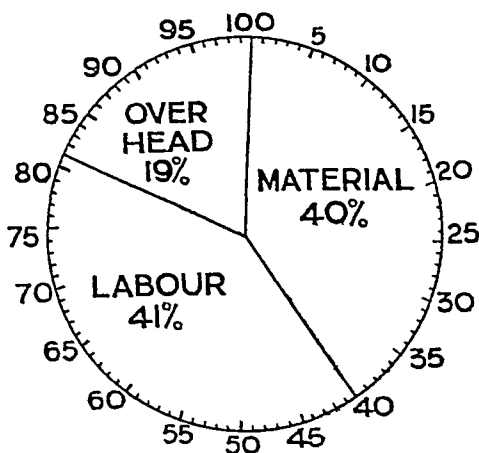
(3) Labour hours can be similarly treated, giving reasons for short time, etc. A separate chart for each man can be drawn for the use of the foreman; or, for each shop, for the manager to check the foreman's results. Lettering can be used to indicate absence, slow workers, sickness, accidents, tool or machine breakage, faulty material, waiting for orders, etc.

(4) The load, or number of orders, or quantity of work, assigned to shops, machines or men, can be indicated to ensure even distribution.

OTHER METHODS OF GRAPHIC PRESENTATION

Circular or "Pie" Charts.—Different elements which go to make up a total, *e.g.* the value of materials, labour, and over-

FIG. 204.



head, can be represented by sectors drawn on a circle, of which the circumference has been marked off into 100 parts. The percentage cost of each sector can thus be measured as in Fig. 204. The sectors may be coloured.

Vertical Bar Charts.

(a) These may be used on ordinary squared paper to compare series, much in the same way as line graphs, but, instead of connecting the plotted points with lines, a "bar" is dropped from each point to the base line.

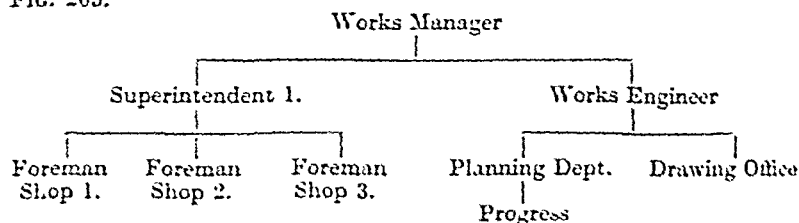
(b) Bars of equal length may be used, each being divided into 100 parts, as in the circular chart; percentages are then shown by different shadings, or colourings.

Organisation Charts may be used to show the relationship of:

(a) Different officials in relation to each other, and to the manager. (Fig. 205.)

(b) The sequence of operation on work.

FIG. 205.



Note.—This chart is not complete, but is given to show the idea of lay-out.

Charting Ideal or Standard Cost, and Actual.—This is useful for demonstrating how near the target actual results come. If vertical bars are used, each bar is made to represent 100 per cent., the first one is divided to show the percentage of materials, labour, and overhead. Each week the actual percentages of the work done are marked on succeeding bars, and thus comparison with the standard is secured.

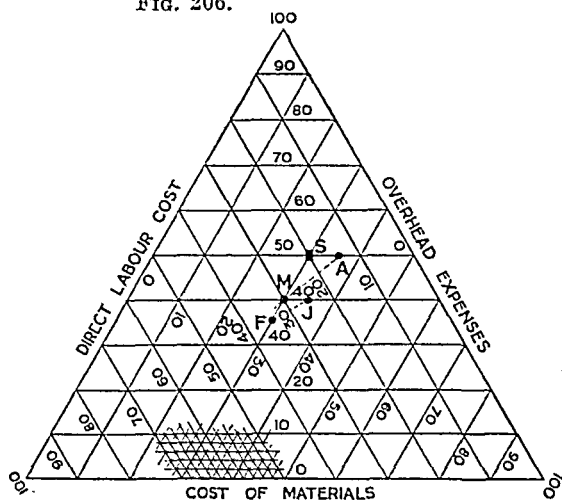
equal-sided triangle but the procedure is simplified by doing so). Mark the base line as, say, material cost, and the other sides of the triangle direct labour and overhead respectively.

The altitude of the triangle, *i.e.* a line from the apex to the centre of the base line, represents 100 per cent. and the sum of the perpendiculars from any point within the triangle to the sides will also be equal to 100 per cent.

Example :

Assume that the total cost (100 per cent.) is made up thus : Material 50 per cent., labour 30 per cent., and overhead 20 per cent. Then on the chart (Fig. 206) where the 50 line parallel to the base is intersected by the 30 line and the 20 line parallel respectively to the labour and overhead sides, a point *S* is found.

FIG. 206.



This point is perpendicularly placed 50 per cent. from the material base, 30 per cent. from the labour side, and 20 per cent. from the expenses side. The sum of the perpendiculars is 100 per cent. If *S* is regarded as the ideal or standard proportion of the elements of cost, this point is then the objective. Now take the actual percentages recorded for four months as follows :

	Standard.	Jan.	Feb.	March.	April.
Material . . .	50	40	35	40	50
Labour . . .	30	35	30	30	35
Overhead . . .	20	25	35	30	15
Total Cost . .	100	100	100	100	100

On plotting these figures, the points ascertained show the degree to which production costs have approached the standard. The

triangles used are ruled as section paper is ruled, with the difference that the intersecting lines are parallel to the sides instead of square. A portion of Fig. 206 has been ruled to illustrate this.

II. STATISTICAL DATA TO AID MANAGERIAL CONTROL

The detailed information necessarily collected for the purposes of the compilation of costs permits of the preparation of other statistics of considerable value for managerial control and the formulation of policy.

Labour and Wages Statistics provide much information of value for staffing control and the supervision of efficiency of utilisation in the various shops and services. Fig. 87 on p. 210 is an example. Losses through labour turnover, i.e. changes in the working personnel, time losses from late coming, shop time lost in changing from one order to the next, idle time in relation to machine use, etc., are examples of controllable losses. Statistics of overtime worked require analyses.

Raw Materials Issued and Production Reports play an important part in managerial control. Material control (issues, purchases, deliveries and quantities, scrap and rejections) necessitates tabulation reports. An example of a production record is given on p. 314. In process costing statistics of production efficiencies may be presented.

Sales Statistics for classes of product, areas, salesmen, etc., form a guide for production, pricing, and selling policy.

III. BUDGETS AND BUDGETARY CONTROL

The practical importance of Budgetary Control and its wide adoption by many manufacturers have been shown by the prominence given to the subject at various International Congresses for Scientific Management, particularly those of Geneva 1930 and London 1935. In relation to the benefits obtained, the cost of preparing budgets and maintaining a system of Budgetary Control has been found to be negligible.

Budgets are prepared for (a) Sales, (b) Production, (c) Overheads, (d) Stock purposes, (e) Financing arrangements, (f) Trading Account.

Sales Budget.—(i) *Period Covered.* This is usually the key to the other budgets prepared. The usual period covered by the budget is (a) one year in the case of trading from stock,

e.g. in light industries and miscellaneous suppliers to who salers, retailers, and the public; (b) three months where production occurs after sales orders have been taken, *e.g.* basic producers in the heavy industries which produce mostly for other industries.

Other notes on the subject appear on pp. 7 and 364.

The statistics for comparison are often prepared for each four-weekly period, and in many cases daily and weekly well.

The budget may be (1) by classes of product or lines, (2) by quantities and items, (3) by geographical sales areas or travelling grounds.

(ii) *Basis*. Sales Budgets may be based on past records, current reports on present conditions in various markets, and sometimes on an economic volume of production, in which case a selling policy and organisation is adopted to stimulate sales to absorb that output.

In distributive industries the total sales are not very difficult to assess, but in some cases the results of new lines and advertising campaigns affect estimates as to existing production. In the basic industries regard has to be had to the trend of trade in the industries supplied, hence the shorter period for such budgets.

The Production Budget is usually based on the Sales Budget.

The advantages are that production can be planned to make the most economical use of machine and plant capacity and labour. The scheduling of departmental expense rates for recovery of overhead (or oncost) as well as piece rates and bonus rates is facilitated, peak loads can often be minimised, overtime expense may be curtailed, and better opportunity for controlling production costs is available. The introduction of Standard Costing methods is possible and costing routine generally is facilitated.

The Purchasing and Stock Budget enables advantage to be taken of a long view purchasing programme, advantageous contracts can often be entered into, and better regulation of stock is obtained.

Trading Account Budgets based on the other budgets are facilitated by the adoption of standard production costs. Sometimes standards of expenses for varying volumes of factor output are adopted. General policy of production and sales can be reviewed and the probable trend of financial results

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provided may be of great assistance from an administrative and financial point of view, particularly for determining forward policy.

In general an important value of Budgetary Control is that the interdependence and need for co-ordination of all sectional activities of the undertaking are emphasised, thus tending to both economy and efficiency.

EXAMINATION QUESTIONS

1. State the principal uses of Charts and Graphs in Costing; suggest any necessary cautions in their use. Give examples of three matters in regard to which you consider this method of illustration would be useful, and describe the kind of chart you would suggest in each case.—*London Chamber of Commerce.*

2. Give an example of the use of graphical representation and explain its uses.—*Royal Society of Arts (Advanced).*

3. Express graphically on the squared paper provided the following information. What deductions would you expect the works manager to make from it and what further information would he probably call for in this connection?

Period.	No. Produced.	Total Cost.			Cost per Unit.		
		£	s.	d.	£	s.	d.
Jan. to March	400	4200	0	0	10	10	0
April	200	1900	0	0	9	10	0
May	250	2062	10	0	8	5	0
June	250	2000	0	0	8	0	0
July	200	1700	0	0	8	10	0
August	200	1700	0	0	8	10	0
September	300	2400	0	0	8	0	0
Oct. to Dec.	500	5000	0	0	10	0	0

Royal Society of Arts (Advanced).

4. By means of a suitable chart describe the route through the works taken by an order from its reception, during all stages of manufacture to its completion ready for despatch.—*Institute of Cost and Works Accountants (Inter.).*

5. Prepare a Trilinear Chart indicating the relative percentages of Material, Labour, and Overhead Costs based on the following monthly totals and showing the average percentages for the six months:

	Material.	Labour.	Overhead.
	£	£	£
January	87,002	65,028	53,28
February	90,104	61,193	52,17
March	95,671	61,311	51,80
April	98,880	61,012	50,71
May	100,101	63,028	49,71
June	105,762	63,117	49,2

Institute of Cost and Works Accountants (F)

6. Prepare a Circular Percentage Chart for each of the following months showing the totals given :

	June. £	July. £	August. £	September. £
Materials . . .	58,069	61,937	68,722	66,418
Labour . . .	34,086	34,712	35,988	35,511
Overheads . . .	25,721	25,982	25,814	24,981
Selling . . .	11,241	11,388	12,721	13,814
Profit . . .	14,892	15,982	16,718	16,219

Institute of Cost and Works Accountants (Final).

7. From the following information, set out a suitable form of chart :

	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Number produced.	1,500	1,860	1,230	1,580	2,130	600
Wages earned :						
	£	£	£	£	£	£
Foundry . . .	890	985	855	875	1,180	290
Automatic Machines . . .	1,620	1,880	1,480	1,610	1,980	950
Milling section . . .	1,555	1,740	1,390	1,420	1,980	810
Assembly . . .	890	965	920	900	1,010	380
Total . . .	£4,955	£5,570	£4,645	£4,805	£6,150	£2,430

Institute of Cost and Works Accountants (Inter.).

8. A Foundry's output for six months shows the following :

	Tons.	Wages. £	Value. £
January . . .	378	151	1,240
February . . .	429	142	1,728
March . . .	527	178	1,823
April . . .	264	115	1,026
May . . .	591	157	1,948
June . . .	438	163	1,717

Graph this table, also show value per ton, and criticise the results.—*Institute of Cost and Works Accountants (Inter.).*

9.	Direct Wages. £	Materials. £	Works Overhead. £
January . . .	1,590	1,660	985
February . . .	2,065	2,245	1,100
March . . .	2,025	2,320	1,005
April . . .	1,870	1,990	965
May . . .	1,680	1,820	1,040
June . . .	2,140	2,495	1,365

Plot a chart setting out the above on a percentage basis, using the method you consider the most suitable for the purpose.—*Institute of Cost and Works Accountants (Inter.).*

10. Bearing in mind that all wages are *not* directly chargeable, design a graph which would enable the management to see whether wages were keeping step with other expenses.—*Institute of Cost and Works Accountants (Inter.).*

11. Prepare a set of charts and briefly describe how they may be used to enable the management effectively to control the factory and

CHAPTER XXX

MUNICIPAL COSTING

Introduction.—In recent years the question of costing by Local Authorities has been prominent, and in view of the importance of Municipal Cost Accounting, the Institute of Cost and Works Accountants adopted certain measures to stimulate wider interest in the subject, including the introduction of a Municipal Session at their National Cost Conferences and of a Municipal Cost Accounting section in their official journal *The Cost Accountant*. Later, in 1932, the Report of the Committee on Public Expenditure (England and Wales), presided over by Sir William Ray, was published, and, to quote Mr. R. G. Nicholson, Borough Treasurer of Rotherham, “the keynote of which might be said to be Costing.” The following year a Departmental Committee was appointed by the Minister of Health to consider Highways Costing, there being represented on this Committee the Institute of Municipal Treasurers and Accountants. The Research Committee of that Institute further undertook the task of investigation for the preparation of a standardised Abstract of Accounts. The adoption of a standardised form of abstract would be a big step towards uniformity in Costing.

There is, however, no generally accepted uniform system for Municipal Costing, but the subject-matter of this chapter is based on actual systems in use, and is written from information supplied or published by the following Municipal Officers, to whom the author extends his thanks and appreciation :

W. H. Boddington, B.Com., F.C.W.A., A.I.M.T.A., Deputy Borough Treasurer, Leyton Corporation; J. Rowland Boffey, A.I.M.T.A., Deputy Borough Accountant, Reigate Corporation; C. H. Durman, A.C.W.A., Cost Accountant, Portsmouth Corporation; A. W. Muse, F.C.W.A., F.L.A.A., of Birmingham Corporation, Public Works Department; R. G. Nicholson, A.C.A., F.I.M.T.A., Borough Treasurer, Rotherham Corporation.

General Observations.—One of the methods of financial control employed by Local Authorities is the operation of a system

subject to the general supervision of the Chief Financial Officer. It would appear a matter for local consideration, but the following arguments for and against must be considered, bearing in mind the fundamental need for closest co-operation between departmental officials and the Costing Department.

Arguments for a Centralised Municipal Costing System.—

(1) Cost control under an accountant experienced in accountancy and costing is desirable, because scientific costing involves technical operations in modern accountancy necessitating the professional skill of a technically qualified Cost Accountant.

(2) A departmental executive, such as the Engineer, should not be responsible for costing his own work, as this violates an important principle in efficient organisation and control.

(3) A municipal costing system should form an integral part of the financial accounting system or be so linked with it as to provide proper reconciliation between the two sets of accounts. Centralised costing simplifies reconciliation with the financial accounts.

(4) The Financial Department has details of all expenditure and charges, many of which are not immediately available to other departments, and is therefore more capable of compiling complete costs and the full and proper proportion of overhead expense. The interest of other departments is to report the lowest working costs, and may result in the exclusion of certain allocations, say of overheads.

(5) Economy may be effected in that mechanical accounting devices can be used to full advantage, and less staff may be needed for centralised work. Some mechanical units can only be employed profitably when there is a large volume of transactions, a condition which decentralisation prevents.

(6) Other economies may be possible in connection with wages department, stores accounting, etc., but whilst a central stores, central wages office, and central transport department might be conveniently arranged, these are not essential for centralised accounting purposes if practical considerations otherwise demand.

(7) The contention that the executive departments cannot obtain the cost information as and when required has

been disproved in practice. Costs can be supplied as quickly and promptly, and more complete by a well-organised central cost office. Time-tables for reports can be worked to, and special daily costs can be arranged for when necessary.

(8) Statistics can be compiled concurrently with cost records, and all statistical data are available in one place.

(9) Centralised control under the Financial Officer gives to the Council and the Public more confidence in reported results.

The Contentions against Centralised Costing are :

(1) Owing to the widely different types of technical services spread over a wide area, most Financial Officers have not a trained cost staff available for adequate cost control, although they invariably have excellent financial control.

(2) A technical executive does not appreciate cost reports prepared independently on work performed, when he is not fully cognisant of how they are compiled.

(3) Urgent cost information is frequently required while work is proceeding, and this is more easily obtained with departmental costing.

(4) Items of cost are better understood by the technical executive concerned, and easier reference for decisions is possible when costing is in his department. The Cost Accountant should be responsible to that head, and not to the Financial Officer, who is not competent to decide matters involving technical considerations.

(5) Co-operation with the Chief Financial Officer is better than centralisation under his control.

(6) Planning must be done departmentally, hence a central cost department could not obtain all necessary information, except through detailed reports which create unnecessary expense and trouble.

(7) It is impracticable when there are trading and non-trading departments each with separate financial control.

(8) There is no advantage, some claim, in having the costing centralised, with cost accounts forming an integral part of the general accounting system.

Uniform Costing in Local Authorities has not been adopted, although much discussion on the subject has taken place. The difficulty arises chiefly because of varying local conditions. Speaking at a National Cost Conference, Mr. G. A. Bryant,

Cost Accountant to the Norwich City Council, pointed out that to achieve uniform costing throughout, all Local Authorities must have uniformity in estimating, in the financial accounts, and in the methods of costing. Certain of the public works and services lend themselves to the adoption of uniform standard units for comparative purposes, but for others definite units could not be prescribed. Mr. A. W. Muse suggests that uniform costs could be set up for comparison as between different classes of authority for (*inter alia*) :

Road and Street Works, Sewer Works, Public Lighting, Refuse Collection and Disposal, Sewage Disposal, Passenger Transport, and Housing Maintenance.

In general, it may be stated that the comparison which would be available under uniform costing methods would be useful for testing efficiencies and effecting economies, but no basis for instituting such uniformity has been found. For Municipal Costing there is, it is claimed, no fixity or static condition to permit of useful uniform costing, but alternatively it is advanced that the adoption of standard costs would provide a basis for comparative purposes more effectively.

Municipal Administration, so far as works and services are concerned, operating under the Council and Committees, is generally under the control of the Engineer and Surveyor; Engineering Assistants and District Surveyors superintend Road, Bridge, and Sewer Works; Architectural Assistants deal with Building and Housing Works; the Lighting Superintendent is responsible for Street Lighting; the Cleansing and Transport Superintendent deals with Street Cleansing, Refuse Collection and Disposal, and Transport. Revenue Producing Departments and Social Services each have their superintendents or managers, and expenditure of all departments is controlled by the Chief Financial Officer.

The important feature is that the activities of Local Authorities are controlled by Committees of the Council, and revenue expenditure is usually limited by allocation.

Unit and Job Costing.—Services and works upon which municipal expenditure is incurred may be dealt with by : (1) The Unit Costing Method or (2) The Job Costing Method.

Unit Costing for municipal purposes is the costing of a Public Service to a convenient unit of cost. It provides a method of comparison of cost of similar service undertaken

by the Local Authority in different districts and at different times. It is conceded generally that to secure the maximum benefit from such Unit Costing unit costs ascertained by all Local Authorities should be properly comparable, as by this means efficiency of services of one Local Authority in comparison with others could be tested: the difficulties in the way of this have already been mentioned.

Units of Cost for Local Authorities.—The schedule below shows suitable units of cost which may be adopted. It is compiled from particulars supplied by municipal accountants (chiefly Mr. W. H. Boddington of the Leyton Corporation and Mr. A. W. Muse of the Birmingham Corporation) and articles published in *The Cost Accountant*, the official journal of the Institute of Cost and Works Accountants. The variety of services operated by Local Authorities necessitates many cost units, but in addition it is advantageous for purposes of comparison and control to define many sub-units, e.g. : compare the unit for "Highways" and those for "Road and Street Works" in the schedule of Units on p. 449. The application of unit costing to various municipal services and works has received considerable attention in recent years.

Observations on Cost Units.—

(3) *Varying Factors* sometimes prevent uniformity in units as between municipalities, but unit costs may be ascertained for internal comparisons. Thus *Sewer Works* may vary owing to depth of excavation, sizes of pipes, brickwork, and sometimes tunnelling; *Street Lighting* units will depend upon whether gas or electricity is the illuminant, and whether different types and numbers of burners are in use; *Street Cleansing*, the recognised unit of "per 10,000 super yards" should properly be based on types of streets, but this has not been adopted; *Sewage Disposal* units have been fixed, and uniformity as between Local Authorities is aimed at. It has been suggested by Mr. J. W. Drury, F.C.W.A., and Mr. J. Finch, A.M.Inst.S.P., of Rotherham, that a unit based on the following formula would be better than the "Million gallons per dry weather flow" Unit:—

$$\text{Volume of sewage in millions of gallons} \times \text{Strength of tank effluent} \times \text{Percentage of purification} = \text{Number of D.F.* Sewage Units.}$$

Schedule of Units of Cost for Municipalities

RATE FUND SERVICES:—

Education—per scholar in average attendance, per 1000 of population.

Public Assistance—per 1000 of population.

Hospitals—per occupied bed.

(a) Wards: per patient-day.

(b) Dispensary: per prescription.

(c) Nurses' Homes: per nurse.

Road and Street Works (Non-Capital Expenditure):—

1. Street Cleansing per 10,000 super yards for each type of surface.

(Watering, Gritting, Snow removal, and Sweeping.)

2. Surface Repairs—per super yard (for each type of material).

3. Tar Spraying—per super yard (for each type of material: bitumen, cold spray, high-viscosity tar, etc.).

4. Traffic Lines—per 100 yards of white line (i.e. length \times times painted).

5. Grass Verges Maintenance—per 1000 super yards.

6. Tram Track Maintenance—per yard of track.

Road Works (Capital Expenditure):—

1. Carriageway—per cubic yard excavated.

per cubic yard of filling.

per super yard of foundation (thickness and type).

per super yard of surface (each type).

2. Footway—per super yard of foundation.

per super yard of paving (each type).

3. Kerb and Channel—per lineal yard of concrete bed.

per lineal yard of kerb (each type).

per lineal yard of channel (each type).

4. Drainage—per cubic yard excavated, per super yard foundation.

per lineal yard piping (each type).

per manhole complete.

per gully fixed.

per pumping hour (when applicable).

5. Other Work—per lineal yard fencing.

per super yard grass verge laid.

per refuge erected.

per traffic signal erected, etc.

Highways—per 10,000 super yards per mile, per 1000 of population.

Sewers, Construction †—per mile or per yard laid.

Sewage Disposal †—per million gallons dry weather flow and per head of population.

Street Lighting—per lamp.

per mile.

per 1000 of population.

N.B.—Sub-units according to type of lamp and illuminant may be used for comparative cost purposes, e.g.—

Electric—per 100-watt lamp.

Gas—per high-pressure lamp.

per low-pressure lamp having regard to number of burners.

Refuse Collection—per ton or per cubic yard, per 1000 of population.

Refuse Disposal—per ton or per cubic yard, per 1000 of population.

Parks—per acre.

per 1000 of population.

Tennis Courts, etc.—per player.

Libraries—per 1000 of population.

Baths—per bather.

Wash Houses—per washer.

Fire-Brigade—per fireman.

per call.

per 1000 of population.

Police—per constable.

per mile of highway patrolled.

per case.

per 1000 of population.

* i.e. Drury-Finch Units.

† See comments above.

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TRADING OR REVENUE PRODUCING DEPARTMENTS:—

Gas—per 1000 cu. ft. made.

per 1000 cu. ft. sold.

per ton of coal carbonised.

Electricity—per 1000 units generated.

per 1000 units sold, etc.

Passenger Transport *—per car-mile (some

use the 100-seat-mile).

per passenger or passenger-mile.

Water—per 1000 galls. consumed (*d.*).

per million galls. consumed (£'s).

per 1000 of population.

Housing—per house (of each type, e.g., 3-bedroom non-parlour, 2-bedroom parlour, etc.).

Markets—per 1000 animals for sale.

per stand or pitch.

Slaughterhouses—per 1000 animals slaughtered.

* See comments on p. 449.

The Compilation of Standards for Comparative Purposes.—The operations of a year may be selected for standard comparisons for future expenditure, care being taken to ensure that the figures represent normal outlay or costs.

The standards may be set up for departments and also for convenient types of expenditure, the following being a useful form :

EXPENDITURE STANDARDS

Services.	Headings of Expenditure.						Departmental Standards.	
	01.	02.	03.	04.	05.	etc.		
A. <i>Rate Fund.</i>							£	£
..... 1.								
..... 2.								
Street Cleansing . . . 3.								
Baths Establishments . 4.								
(see p. 451) etc.								
B. <i>Trading Depts.</i>								
Tramways . . . 21.								
Electricity . . . 31.								
etc.								

Departmental executives can be notified of the actual controllable expenditure, compared with the standard, at convenient periods of a month, etc., on a form shown on p. 451.

Non-controllable expenditure like interest payments, sinking fund contributions, rates, taxes, etc., may be omitted to give emphasis to the items controllable departmentally.

Standards are amended periodically to allow for extended or reduced activities. The standards set up are not necessarily the ideal or perfect position, but simply a basis for comparisons.

In addition to departmental expenditure standards, standards may be set up for various units of cost in each of the authority's services.

BATHS ESTABLISHMENTS

Expense Code No.	Standard.	Estimate Year Ended 19...			Actual months to 19...			Percentage of Actual to	
								Standard.	Estimate.
41.01 41.02 etc.	£	£	s.	d.	£	s.	d.	%	%

(2) Overheads of the Departmental Works, Services, and Trading Departments, viz. : (a) Departmental office expenses (including accounting staff and proportion of Central Expenses); (b) Supervisory Charges (including salaries of the executive officer and technical staff and wages of foremen); (c) Depot Expenses (or Stores Expenses) including wages of superintendent and men handling materials.

Items in Group (1) are usually allocated at the close of the financial year, and the amount is that actually incurred; those in Group (2) are distributed during the year, since rechargeable accounts, bearing their proportion of overheads, are normally rendered monthly. For Costing purposes *all* overheads should be distributed over services and works.

Allocation of Overheads. Many methods are used and no uniform plan has been adopted.

Group 1. Some apportion Central Expenses from officials' diaries, but this laborious analysis can be avoided by establishing Duty Schedules for the various officials, thus permitting allocation on an approximate time basis, which should be sufficiently accurate.

All other expenses not allocable on one of the customary bases (floor space, etc.) should follow the remuneration proportions. Needlessly meticulous analysis should be avoided.

Group 2. A useful method is to allocate wages and salaries weekly (or monthly) to (a) Departments' own works, (b) Works for Corporation Departments, (c) Works for Private Parties. Remaining expenses can then be apportioned proportionately to these totals, excepting where any can be allocated by usual methods to each of these divisions.

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Summary Cost Sheets showing operating costs may be prepared in the form presented on pp. 452 and 453, which are from a lecture by Mr. W. H. Boddington to the Institute of Municipal Treasurers and Accountants Students Societies.

Motor Buses.	Expenditure.		Per 100- Seat-Mile.	Per Bus-Mile.	Per Passenger.
	£	%	d.	d.	d.
Traffic Expenses	38,879	40.29	11.46	4.17	0.68
Repairs and Main- tenance	12,732	13.19	3.76	1.46	0.22
Power	23,686	24.54	6.98	2.72	0.41
	75,297	78.02	22.20	8.65	1.31
Other Expenses	9,946	10.31	2.93	1.14	0.17
Working Expenses	85,243	88.33	25.13	9.79	1.48
Loan Charges	9,096	9.43	2.68	1.05	0.16
General Charges	2,164	2.24	0.64	0.25	0.04
	96,503	100.00	28.45	11.09	1.68
			Income.		
			Per 100- Seat-Mile.	Per Bus-Mile.	Per Passenger.
			d.	d.	d.
Income	92,673		27.33	10.66	1.61
Deficiency	3,830				
Bus Mileage				2,066,918	
Passengers				13,791,497	
Average number of buses in commission				51	
Average seating capacity				39	

Water Supply.					Cost per 1000 Gallons Con- sumed.	Cost per Million Gallons Con- sumed.	Cost per 1000 of Popu- lation Supplied.
	£	£	£	%	d.	£	£
Expenditure : Catchment Area and Storage . . . Distribution . . .		5,360 8,842		5.19 8.57	0.35 0.57	1.44 2.38	26.28 43.34
Working Expenses Rates and Taxes . . Loan Charges . . . General Charges . .	20,659 57,163 11,161	14,202		13.76 20.02 55.40 10.82	0.92 1.33 3.69 0.72	3.82 5.56 15.38 3.00	69.62 101.27 280.21 54.71
		88,983	103,183	100.00	6.66	27.76	505.81
Income : Grants Other Receipts . .		1,995 101,581					
			103,576				
Surplus			£391				
					Thousand of gallons con- sumed Population Supplied		
					3,716,284 204,000		

healthy competition, and (f) to facilitate investigations and indicate where costs are excessive and how economies may be possible.

Costing Scheme for Borough Engineer's Department.—The scheme is a centralised system employed by Mr. R. G. Nicholson, A.C.A., F.I.M.T.A., Borough Treasurer of Rotherham, by whose courtesy it is here described. In general, it is applicable to

Mental Hospital.	Average No. of Occupied Beds, 581. Patient Days, 211,289.			Cost.	
	Expenditure.			Per Occupied Bed.	Per Patient Day.
	£	£	%	£	s.
Salaries	14,421		39.87	24.82	1.37
Provisions	5,646		15.61	9.72	0.53
Heating, Lighting, and Cleaning	1,801		4.98	3.10	0.17
Medicines and Appliances	183		0.51	0.32	0.02
Furnishing	739		2.04	1.27	0.07
Miscellaneous	7,175		19.84	12.35	0.68
		29,965	82.85	51.58	2.84
Loan Charges		5,755	15.91	9.91	0.54
General Charges . . .		450	1.24	0.77	0.04
		36,170	100.00	62.26	3.42
Income		6,719			
NET COST		£29,451		50.69	2.79

all Public Services, including Trading Departments. As 20,000 accounts entailing 200,000 postings a year are operated in the Rotherham scheme, the work is facilitated by the use of a Burroughs Stores and Cost Posting Machine and a Burroughs Listing Machine; an operator can post 100 items an hour to the ledger cards.

Stores Accounting.—All materials are coded under a five-figure code; the first two numbers indicate the class, and the others the article. Thus, 02001, (02) represent cement, lime, etc., class and (001) a grade of cement.

Goods bought in bulk are recorded in the smallest units likely to be used. Thus cement is entered in units of quarters,

STORES LEDGER					Catalogue No. 02001.				
Description: Portland Cement-Pellman.									
Supplier: 1. Dulles, Ltd.					Ordering Level.		Bin. No.: Y.A.		
					Maximum Stk.		Unit: 1 Qr.		
					Minimum.				
Issues.		Receipts.		Price.	Supplier No.	Date.	Balance.		
Qty.	Value.	Qty.	Value.	£			Qty.	Value.	
243	£ 4. 1	243	£ 4. 1	0.0167	1	Apr. 2	243	£ 4. 1	
	15 10 0		15 10 0			"	243	0 0 0	
			15 10 0			"	243	0 0 0	

GOODS INWARD TICKET 10,729.

Supplier : G. T. Duke, Ltd.		Storekeeper's Initials.		Date : 12.3....	
				Order No. : 9815	
Description : Cement-pelican				Invoice passed : Highways Apl. 19...	
Quantity : 10 tons				If direct charge.	Vehicle No.
					Estimate No.
					Job. No.
Quantity in Units.	Rate.	Amounts.			Stores Catalogue No. : 02001
800		£ 19	s. 10	d. 0	

Stores Issues Requisitions are used in the usual manner (see p. 49). In the Rotherham scheme these are made in duplicate, as one copy is used for Stores Ledger posting, and one as a posting medium for the Cost Ledger as described later. The goods are unitised and priced from the Stores Ledger Cards, both copies being priced together to avoid error. *Returns to Stores* are made on Stores Returns Notes and similarly dealt with.

A separate ticket is prepared for each item on a requisition, these tickets being used for easier posting by machine.

Posting to the Stores Ledger is done weekly in one total for each material. The quantities and amounts are listed first to find the posting total. (This operation is equivalent to sum-

STORES REQUISITION No. 1944.		
Date		
Please supply to.....		
Charge to Job : Wickersley Rd. (No. 2753).		
Qty.	Description.	Storekeeper's Catalogue No.
7 16 3 3 tons 3½ "	Cement Pebbles Sand	02001 05002 08016
Foreman : J. W. B.		Storekeeper : W. S.
Carter's signature : J. Hill		

STORES ISSUES POSTING TICKET

STORES ISSUE TICKET.			
Where Used : Wickersley Rd.		Date : 30.3.	
Description : Cement		Reqn. No. 1944	
Quantity : 7 tons 16 cwt. 3 qrs.		Estimate No. 22/6	
		Job. No. 2753	
Units.	Rate, £.	Amount.	Stores Catal. No. 02001
627	0.02437	£15 6 0	

Stores Returns Notes similarly printed in red as credits. Tickets for each department printed on paper of distinctive colour to facilitate sorting.

Sewerage Works.

(The code list is arranged to facilitate the preparation of the Annual Cost Returns of the Ministry of Health for Sewage Disposal Works.)

Code for Heads of Expenditure.	Sub-Code for Costing Kinds of Sewage Treatment.
125. Salaries.	1. Screening and Tank Treatment.
126. Wages and National Insurance.	2. Filtration and Humus Tank Treatment.
127. Materials (excluding Repairs and Chemicals).	3. Activated Sludge Treatment.
128. Chemicals.	4. Sludge Treatment, including Humus Sludge.
129. Haulage.	5. Pumping.
130. Ejectors, Power.	6. Unallocated Expenditure.
131. Electricity at Works.	7. Capital.
132. Repairs to Buildings, etc.	8. Ejectors and Pumps.
133. Ejectors and Pump Maintenance.	9. Stable Expenses.
134. Rates, Rent, Insurance.	10. Holidays.
135. Loan Charges.	11. Pensions.
136. Sundries.	

Housing Construction.—A Code No. allotted to each building estate, e.g. erection of 100 houses in red brick and rough cast at Town Estate (50 parlour, 50 non-parlour).

Sub-Code Nos.	Operation Sub-Code Nos. Common to All Types.
01 Parlour, 3-bedroom houses.	1. Clearing and Excavating.
02 Non-parlour, 3-bedroom houses.	2. Foundations.
03 do. 2-bedroom houses.	3. Brickwork.
04 2 Blocks of 6 each in red brick.	4. Tiling.
05 3 do. 4 each in rough cast.	5. Slating.
etc.	6. Plastering (internal).
	7. do. (external).
	8. Carpentry.
	9. Joinery.
	10. Glazing.
	11. Plumbing.
	12. Drains.
	13. Fences, etc.
	14. Painting and Decorating.
	15. Hearths, etc.
	16. Making good after Tradesmen.

Public Baths Expenditure.—In the code (p. 458), the first number in the code designates the Baths Department; the second, a particular Baths Establishment; the last two the heading of expenditure.

Example of the Use of the Code.—Surface-Dressing Classified Road A.6021 (Broom Road) Code reference for costing is 22/8. Traffic signal maintenance on Sheffield Rd. (A.630), 19/14. For Wages expended on Activated Sludge Treatment the Cost

BATHS ESTABLISHMENTS

	No. 1. High St.	No. 2. Hill St.	No. 3. City Rd.
Wages	41.01	42.01	43.01
National Insurance	41.02	42.02	43.02
Coal and Cartage	41.03	42.03	43.03
Towels and Soap	41.04	42.04	43.04
Water	41.05	42.05	43.05
Electricity	41.06	42.06	43.06
Telephones	41.07	42.07	43.07
Printing, Advertising	41.08	42.08	43.08
Rent, Rates, Taxes	41.09	42.09	43.09
Insurance	41.10	42.10	43.10
Repairs	41.11	42.11	43.11
Sundries	41.12	42.12	43.12
Capital items	41.20	42.20	43.20

Code is 126/3. If there is a Job Order to be separately costed then the Code numbers are quoted with the addition of the Job Number.

Job Order Work.—Orders are issued in quadruplicate, two go to the Foreman, one to the Cost Office, one is retained in the Borough Engineer's Office. Separate Cost Accounts are opened for these orders. When completed and approved by the Engineer, any re-chargeable jobs are then passed to the Rental Section of the Borough Treasurer's Department for collection.

Collection and Analysis of Expenditure Data.—This is dealt with under the usual headings, as: Wages, Stores, Materials, Direct Charges, Services (Motors, Rollers, Plant Hire, etc.).

Wages.—The Time Record of gangs of labourers is prepared by a timekeeper. Skilled men fill in individual Time Sheets.

The Borough Engineer's Department prepares Wages Sheets from the Time Sheets, both of which are passed to the Cost Office.

From this information it is usual for the Cost Office to prepare a Wages Abstract (see p. 188), but at Rotherham Wages Tickets are prepared (one for each job upon which each man has worked) for posting purposes by machine to the Cost Ledger Cards :

Borough Engineer's Dept.						WAGES TICKET.			
Week ending : 24th Apl., 19... Section : Highways No. 1.						Check No.	420		
						Classification No.			
Hours.			Rate.	Amount.			Vehicle No.		
Ord.	O.T.	Total. 38½	1/1	£	s.	d.	Estimate No.	22/6	
				2	1	8	Job No.	2753	
				2	1	8			

The aggregate for each man is agreed with his wage on the Wages Sheet; the total aggregate of wages posted to the Cost Accounts is agreed with total wages paid.

Materials from Stores.—The total of requisitions of each material for each job or account number is posted from the Materials Abstract to the Cost Ledger Accounts. At Rotherham this is done by sorting the Materials Cost Tickets into code and job number order ready for the machine operator to post direct to the Cost Ledger Cards.

Materials Delivered Direct to Jobs.—The procedure as to ordering and recording is the same as for Stores Materials, except : (1) the foreman signs the Delivery Note and sends to the

COST LEDGER ACCOUNT.												Code No.	22/6
Class 1. Roads. A.6021.												Job No.	2753
Wickersley Road.													
Job. Repairs to Carriageway from Stag Lane to Middle Lane.													
Date.	Wages.			Stores.			Other Items.				Total to Date.	Remarks.	
	£	s.	d.	£	s.	d.	Ref. No.	£	s.	d.			

[Abbreviated.] As the card is used for machine posting, money columns are not printed.

Storekeeper, (2) instead of the Stores Code Number the proper job or estimate number is quoted on the Goods Received Note.

Direct Expenses are dealt with by debits as for Stores Issues. Direct charges such as Insurance, Road Charges, Rates, etc., are debited under proper allocation to code and job numbers.

Subsidiary Services.—Motor Transport, Rollers, Plant Hire, Stores, Private Works, Establishment, etc., are each costed as such by allocating expenditure so appropriated.

Stores expenses include stores wages, repairs, heating, lighting, rates, insurance, loan charges, etc., at the stores and the cost of transport handling of materials into stores.

Any main service utilising a subsidiary service is debited on a predetermined basis defined below. All such debits are posted in the column headed "Other Items" shown on the specimen Cost Ledger Account above. Amounts so debited are credited to the appropriate Subsidiary Service Cost Account, or may be dealt with through a Service Expense Control Account.

(e) *Tools* such as picks, shovels, etc., are charged as a percentage on prime cost to each job. The rate is based on the annual maintenance cost and is revised annually.

(f) *Timber*, scaffolds, etc., are charged on a hire basis as for plant.

(g) *Stores Expenses*.—A percentage calculated to cover handling, etc., is added to the value of Stores Issued. (*Note*.—Special rates are used in the case of Stores charged to Classified

SPECIMEN TIME SHEETS

Borough Engineer's Dept.				PLANT OR TIMBER ON HIRE.		
Estimate or Job No.	Quantity.	Description.	Date Issued.	Date Returned.	Time to be Charged.	Rate.

CARTER'S (HORSE TRANSPORT) TIME SHEET					
Carter.....					
Week ending.....19...					
Date.	From.	To.	Destination.	No. of Loads.	Hours Worked.

Tues.	MOTOR TRANSPORT AND ROLLERS TIME SHEET							Date.....
	Mileage Recorder.		Start.....	Finish.....	Total.....			
Wed.	Driver.....		Mate.....		Vehicle No.....			
	A/c No.	Destination.	Arrive.	Depart.	Time.	Details of Load.	Weight.	Recd. by.

Issues : Petrol..... Oil		Driver's Remarks :	Job No.	Hrs.	Road.

Verified by	Allocated by	
M.T. Supt.		

Roads and Ministry of Transport Grant Jobs calculated on a unit basis, *e.g.* handling charges per cwt. bag of cement, per manhole cover and frame, per gully grate, etc.). All the stores materials for a particular cost account are listed and totalled, on which the percentage is added in one operation and one machine posting.

Establishment Charges, including the Town Clerk's, Borough Treasurer's, and Borough Engineer's Departments should be apportioned over all the Services of the Corporation. Owing

to many complications as to a suitable basis, no general apportionment is made at Rotherham, but some apportionment is made in respect of re-chargeable work, and is charged as a fixed percentage. (See, however, p. 450.)

Cost Control Accounts.—The main heads of the Cost Code are identical with the heads of expenditure in the annual estimates, and therefore of the Financial Books.

In the scheme described the Tally Roll List Totals are the totals posted to the Cost Accounts. By posting corresponding totals to the respective Control Accounts (say quarterly) the latter provide a complete analysis of expenditure under Estimate Headings, and these figures may be used for posting the expenditure side of the Financial Accounts.

Returns of Cost Supplied to Departments.—Weekly Returns are supplied to the Borough Engineer showing the cost of each Classified and non-Classified Road (with amounts under each sub-code head); detailed cost of Collection and Disposal of Refuse; cost of each vehicle under sub-codes and its earnings; costs of all other services; cost of special jobs week by week and on completion. Also a monthly return of his expenditure under appropriate Estimate headings.

Returns are made within seven days of the end of a week.

should correspond with the Chief Financial Officer's Rate Estimates, amplified with any desired sub-coding.

The following remarks refer to the Borough Surveyor's Section, and the costing is not centralised.

WAGES ABSTRACT

SUMMARY OF DAILY TIME SHEETS.

Reigate Corporation.

Highways Dept.

Week ended

Total Job Costs to Wages
Analysis Abstract fo. 23/9 £.....

Check No.	Wages. £ s. d.	206/2.	208/3.		240/6.	etc.	etc.		Total (Cross casts).
		£ s. d.	£ s. d.		£ s. d.				£ s. d.
				[Sheet (16 columns) broken for convenience of printing.]					
		306/1	307/3		etc.				
		£ s. d.	£ s. d.						
		401/2	402/1		etc.				
		£ s. d.	£ s. d.						
	£								Total

The amount for each job is transferred weekly to the Wages Analysis Abstract, on which weekly time sheets are also analysed. An abbreviated form of Abstract is shown on p. 188.

Manual Labour.—Daily time sheets are prepared, and summarised weekly. These documents are used for preparation of the Pay Sheets.

The Pay Sheets are analysed on the Wages Analysis Abstract

under Job or Code Numbers. The total for each number is posted to the appropriate Cost Sheet or Cost Account.

Materials.—A daily return of Materials Issued is sent to the Costing Section by the Storekeeper. Values are there inserted and the total of the sheet is transferred to a summary, viz., the Materials Issued Abstract. This abstract is merely a summary of the daily totals for a quarter.

Each issue on the Daily Return is posted (*a*) to the credit of the Stores Ledger, the folio of the ledger being inserted on the Return, (*b*) to the debit of the appropriate Cost Account. For the latter the posting reference is the Stores Ledger Folio.

Returns to Stores are similarly dealt with on separate sheets. The postings to the Job Cost Ledger are in red ink in the Materials column, as a separate credit column is not used.

Direct Costs.—As Centralised Costing is not in operation, the posting from analysed committee schedules or expenditure analysis book cannot be done. The procedure (using invoices of the Roads and Bridges Committee only) is as follows: Invoices are analysed in the Finance Dept., so that the amount charged to each Rate Estimate head is available each month. Also, assuming the two systems are operating on the same Estimate Code, the expenditure is available under Cost Code numbers (jobs, etc.). Such totals can thus be posted direct to the Cost Accounts, using the Expenditure Journal or Committee Schedule

MUNICIPAL COSTING

465

DATE : 10 Sept., 19...
 DRIVER : R. Jones
 Mate.....
 REIGATE CORPORATION
 LORRY NO. 3

Journey No.	Place of Loading.	Place of Delivery.	Material Hauled.	Actual Weight Carried.		Miles Covered.		Ton Mileage.	Time for each Journey.		Hrs.	Job Cost No.	Rate : 3/- hr.		
				Tons.	Cwts.	Loaded.	Empty.		Departed.	Arrived.			£	s.	d.
1	Reigate Depot	Castledfield Rd.	Tarmac	2	0	2 1/2		4.2	7.30	7.45	1	200/1		3	0
2	Castledfield Rd.	Tip, Brighton Rd.	Old Tarmac	1	10	3		4.5	8.45	9.0	1	do.		3	0
3															
4															
etc.															
TOTALS															

I hereby certify the above particulars to be correct.

(Signed).....Driver.

Details of Standing Time to be entered above on the line under the preceding Journey.

Mileometer Readings :

Start : 18,733
 Finish : 18,700

TOTAL MILES RUN 33

Examined and Certified Correct.....
 Superintendent.

Examined by

At Work. Hours.	Under Repairs. Hours.	Idle Time. Hours.	No. of Journeys (loaded).
Mileage (loaded).	Mileage (empty).	Tonnage (carr'd).	Ton Mileage.

For Office use

HOBSON ENGINE AND SHEDDING DEPARTMENT

FOR THE QUARTER ENDED December, 1900.

Job.	Costs Completed		Add - Profit for Cost Sheet (shown in red).		Total Recover- able.	Account No.	Housing Repairs Account.		School Repairs		Miscel- laneous Admin.	
	£.	d.	£.	d.	£.	d.	£.	d.	£.	d.	£.	d.
1	10	0	0	0	10	0	10	0	10	0	10	0
2	10	0	0	0	10	0	10	0	10	0	10	0
3	10	0	0	0	10	0	10	0	10	0	10	0
4	10	0	0	0	10	0	10	0	10	0	10	0
5	10	0	0	0	10	0	10	0	10	0	10	0
6	10	0	0	0	10	0	10	0	10	0	10	0
7	10	0	0	0	10	0	10	0	10	0	10	0
8	10	0	0	0	10	0	10	0	10	0	10	0
9	10	0	0	0	10	0	10	0	10	0	10	0
10	10	0	0	0	10	0	10	0	10	0	10	0
11	10	0	0	0	10	0	10	0	10	0	10	0
12	10	0	0	0	10	0	10	0	10	0	10	0
13	10	0	0	0	10	0	10	0	10	0	10	0
14	10	0	0	0	10	0	10	0	10	0	10	0
15	10	0	0	0	10	0	10	0	10	0	10	0
16	10	0	0	0	10	0	10	0	10	0	10	0
17	10	0	0	0	10	0	10	0	10	0	10	0
18	10	0	0	0	10	0	10	0	10	0	10	0
19	10	0	0	0	10	0	10	0	10	0	10	0
20	10	0	0	0	10	0	10	0	10	0	10	0
21	10	0	0	0	10	0	10	0	10	0	10	0
22	10	0	0	0	10	0	10	0	10	0	10	0
23	10	0	0	0	10	0	10	0	10	0	10	0
24	10	0	0	0	10	0	10	0	10	0	10	0
25	10	0	0	0	10	0	10	0	10	0	10	0
26	10	0	0	0	10	0	10	0	10	0	10	0
27	10	0	0	0	10	0	10	0	10	0	10	0
28	10	0	0	0	10	0	10	0	10	0	10	0
29	10	0	0	0	10	0	10	0	10	0	10	0
30	10	0	0	0	10	0	10	0	10	0	10	0
31	10	0	0	0	10	0	10	0	10	0	10	0
32	10	0	0	0	10	0	10	0	10	0	10	0
33	10	0	0	0	10	0	10	0	10	0	10	0
34	10	0	0	0	10	0	10	0	10	0	10	0
35	10	0	0	0	10	0	10	0	10	0	10	0
36	10	0	0	0	10	0	10	0	10	0	10	0
37	10	0	0	0	10	0	10	0	10	0	10	0
38	10	0	0	0	10	0	10	0	10	0	10	0
39	10	0	0	0	10	0	10	0	10	0	10	0
40	10	0	0	0	10	0	10	0	10	0	10	0
41	10	0	0	0	10	0	10	0	10	0	10	0
42	10	0	0	0	10	0	10	0	10	0	10	0
43	10	0	0	0	10	0	10	0	10	0	10	0
44	10	0	0	0	10	0	10	0	10	0	10	0
45	10	0	0	0	10	0	10	0	10	0	10	0
46	10	0	0	0	10	0	10	0	10	0	10	0
47	10	0	0	0	10	0	10	0	10	0	10	0
48	10	0	0	0	10	0	10	0	10	0	10	0
49	10	0	0	0	10	0	10	0	10	0	10	0
50	10	0	0	0	10	0	10	0	10	0	10	0
51	10	0	0	0	10	0	10	0	10	0	10	0
52	10	0	0	0	10	0	10	0	10	0	10	0
53	10	0	0	0	10	0	10	0	10	0	10	0
54	10	0	0	0	10	0	10	0	10	0	10	0
55	10	0	0	0	10	0	10	0	10	0	10	0
56	10	0	0	0	10	0	10	0	10	0	10	0
57	10	0	0	0	10	0	10	0	10	0	10	0
58	10	0	0	0	10	0	10	0	10	0	10	0
59	10	0	0	0	10	0	10	0	10	0	10	0
60	10	0	0	0	10	0	10	0	10	0	10	0
61	10	0	0	0	10	0	10	0	10	0	10	0
62	10	0	0	0	10	0	10	0	10	0	10	0
63	10	0	0	0	10	0	10	0	10	0	10	0
64	10	0	0	0	10	0	10	0	10	0	10	0
65	10	0	0	0	10	0	10	0	10	0	10	0
66	10	0	0	0	10	0	10	0	10	0	10	0
67	10	0	0	0	10	0	10	0	10	0	10	0
68	10	0	0	0	10	0	10	0	10	0	10	0
69	10	0	0	0	10	0	10	0	10	0	10	0
70	10	0	0	0	10	0	10	0	10	0	10	0
71	10	0	0	0	10	0	10	0	10	0	10	0
72	10	0	0	0	10	0	10	0	10	0	10	0
73	10	0	0	0	10	0	10	0	10	0	10	0
74	10	0	0	0	10	0	10	0	10	0	10	0
75	10	0	0	0	10	0	10	0	10	0	10	0
76	10	0	0	0	10	0	10	0	10	0	10	0
77	10	0	0	0	10	0	10	0	10	0	10	0
78	10	0	0	0	10	0	10	0	10	0	10	0
79	10	0	0	0	10	0	10	0	10	0	10	0
80	10	0	0	0	10	0	10	0	10	0	10	0
81	10	0	0	0	10	0	10	0	10	0	10	0
82	10	0	0	0	10	0	10	0	10	0	10	0
83	10	0	0	0	10	0	10	0	10	0	10	0
84	10	0	0	0	10	0	10	0	10	0	10	0
85	10	0	0	0	10	0	10	0	10	0	10	0
86	10	0	0	0	10	0	10	0	10	0	10	0
87	10	0	0	0	10	0	10	0	10	0	10	0
88	10	0	0	0	10	0	10	0	10	0	10	0
89	10	0	0	0	10	0	10	0	10	0	10	0
90	10	0	0	0	10	0	10	0	10	0	10	0
91	10	0	0	0	10	0	10	0	10	0	10	0
92	10	0	0	0	10	0	10	0	10	0	10	0
93	10	0	0	0	10	0	10	0	10	0	10	0
94	10	0	0	0	10	0	10	0	10	0	10	0
95	10	0	0	0	10	0	10	0	10	0	10	0
96	10	0	0	0	10	0	10	0	10	0	10	0
97	10	0	0	0	10	0	10	0	10	0	10	0
98	10	0	0	0	10	0	10	0	10	0	10	0
99	10	0	0	0	10	0	10	0	10	0	10	0
100	10	0	0	0	10	0	10	0	10	0	10	0

[Following may be utilized for further analysis.]

Tools and Plant.—A percentage (usually about $1\frac{1}{2}$ per cent.) is added to prime cost of each job using plant to cover this item.

Recoverable Job Costs.—Instruction sheets are issued to foremen, who insert date of completion and pass to the Cost Office.

Job Cost Sheets are ruled off quarterly for balancing purposes.

CONTROL ACCOUNTS.

Balancing the System.—At the end of each quarter it is essential to extract the analysis of Wages, Materials, Transport, etc., in order to provide the information for posting to the General Rate Fund Ledger, and balancing the costing accounts. The form of Job Cost ruling in this system renders this information readily available (pp. 466 to 468).

Where sub-coding has been introduced, it will be necessary to summarise several Job Cost Sheets on to one sheet to provide totals for the "rate estimate" items of expenditure, and when this has been done, the total of the columns of the Job Costs Sheets, and sectional controls introduced, should be transferred to a Job Costs Extract Book.

This extract book will contain separate pages for Wages, Materials, Tools and Plant, and Transport, and additional columns for sub-totalling as required for Ledger purposes, together with folio columns. The Transport page should contain analysis columns corresponding with the columns on the Job Cost Sheets.

Transport Control Account.—A Control Account is opened for each vehicle (see specimen on p. 470), the debit side showing the cost of running the vehicle for the quarter as transferred from the Job Cost Sheets already completed, the credit side entry being the total of the daily returns obtained from the Vehicle Abstract or Quarterly Summary.

When more than one vehicle of the same class is in use, a control account for the whole of the vehicles of that class should be kept on the columnar form. This shows deficits brought forward, costs for quarter, and surpluses carried forward, against surpluses brought forward, allocations for quarter, and deficits carried forward, and can be utilised for fixing the hourly charge for the next quarter. (See specimen on p. 471.)

TIME TABLE AND ORGANISATION OF COSTING SYSTEM

Daily Duties—Outside Staff.

Time Sheets.

Drivers' Returns.

Materials :—

1. Received Sheet.
2. Issued Sheet.
3. Returns to Stores Sheet.
4. Stores Book Entries.
5. Emergency Requisitions—materials for Stock.

*Daily Duties—Costing Staff.**Vehicles—Daily Returns :—*

1. Extensions of charges to jobs for user.
2. Posting of charges to Job Costs.
3. Daily totals to appropriate abstract for each vehicle.

Materials Received Sheet :—

1. Insertion of cost of materials from invoices.
2. Posting to Stores Ledger.
3. Daily total to abstract.

Materials Issued :—

1. Insertion of value of materials used.
2. Posting to Stores Ledger.
3. Daily total to abstract.
4. Posting issues to Job Costs.

Returns to Stores :—

1. Insertion of value of materials returned.
2. Posting to Stores Ledger.
3. Daily total to abstract.
4. Crediting to Job Costs (in red—materials column).

Recoverable Jobs :—

1. Issuing Instruction Sheets—new jobs.
2. Recording dates of jobs completed on Job Costs.

Weekly Duties—Outside Staff.

Time Sheets.

Weekly Duties—Costing Staff.

Craftsmen's Analysis Sheets—Thursday morning.

Preparation of Pay Sheets—Wednesday to Thursday noon

Wages Analysis Abstract—Monday.

Wages Posting to Job Costs—Tuesday.

*Monthly Duties—Costing Staff.**Materials—Storekeeper's Requirements :—*

1. Insertion of estimated prices.
2. Preparation for Chairman's signature.
3. Issuing Orders to Tradesmen.

Materials—Invoices :—

1. Checking with Daily Materials Received Sheet.
2. Insertion of Order number and invoice amount in Requisition Binder.
3. Summarising materials invoices for Committee schedules.

Direct Expenditure—Invoices :—

1. Checking with Requisition Books.*
2. Summarising and allocations for schedules for Committee.*
3. Insertion of estimate numbers.*

Direct Costs :—

1. Apportionment of annual charges—first week of year.
2. Analysis of copies of Committee schedules.
3. Totals to Journal.
4. Posting to Job Costs.

*Quarterly Duties—First 10 Days.**Working Day.**Duty.*

- 1st. Reconciliation of Stocktaking Sheets
Preparation of Over-Issues Sheet (copy to Store-keeper)
Preparation of Under-Issues Sheet (copy to Store-keeper)

*Working Day.**Duty.*

- 1st. Total quarterly abstracts for vehicles
Total vehicle columns on job cost sheets
Total materials—received abstract
Total materials—issued abstract

* Three days before Committee.

Mechanical Accounting.—In municipalities where the volume of work is sufficiently great the punched-card system for sorting and tabulating on such machines as the Powers and Hollerith can be employed. Mr. G. A. Bryant, F.C.W.A., of Norwich Corporation, has devised and operated such a scheme, and Birmingham Corporation has employed Hollerith machines since 1916.

Needle-Sorting by Hand, of which the Paramount System is an example, can be used for smaller installations.

Cards of any convenient size or shape are supplied ready punched with a series of holes along one or more edges, the number and position of the holes being determined by the headings on the card. Each hole stands for a number or value, in relation to the headings. Codes are used to reduce the number of holes to a convenient limit.

The details written on the card are represented on the edge of the card by snipping out the holes representing each item. This is done with a pair of nippers or by a key punch for large numbers.

When a stack of cards has been so slotted, say for materials and labour charged against jobs, all the cards for labour on a particular job can be separated easily, by passing a long needle through the appropriate hole and lifting the cards edgewise. Those cards with the holes cut away drop, leaving the others on the needle. Cards of a particular slotting when placed in a stack show a channel, and should a wrong card be in the bundle its presence is at once noticeable, thus giving a visible check in accuracy. Summaries can be then made on listing and adding machines.

The Use of Machines.—Many operations in connection with costing can only be done mechanically in the largest Local Authorities offices. It is the adoption of mechanical devices which gives full and regularly prompt returns so necessary to adequate control by executive officers.

Cost Control Accounts for Municipalities.—The following is a simple example of a set of control accounts described by Mr. C. H. Durman, of Portsmouth Corporation, in *The Cost Accountant*.

Different municipalities have different methods of keeping the financial records, and whilst the system to be described may be adapted to any set of circumstances, it will simplify matters if certain assumptions are made regarding the method of keeping the accounts, and then the operation of the system is described

within those set conditions. The first assumption is that the Abstract of Accounts is compiled from a General Ledger, to which postings are made from three possible sources, viz. :

(a) *The Transfer Journal*—which records charges made by one committee on another and in which is analysed the charges for rates, telephones, insurance, etc. ;

(b) *The Invoice Journal*—a term which is self-explanatory ;
and

(c) *The General Payments Journal*—which records such other expenses as purchase of property and sundry periodical payments, such as road rentals, car and cycle allowances, etc.

balance at the end of the year will again represent the value of stocks.

Control Accounts.—These deal with the totals of the elements of cost, there being one account for each element. At the end of the financial year the balance of each of these accounts should be nil, with the exception of the Stores Control Account, which has a balance representing the value of stores in hand.

Wages Paid.—Wages are analysed by the Cost Office and agreed in total with the pay-roll. This total is then journalised as follows :

		Journal Entry No. 1.		
<i>Costing Books—</i>			£	£
Wages Control A/c.	Dr.	2	1200	
To General Ledger Adjustment A/c.		1		1200
Being wages paid.				
<i>Financial Books—</i>				
Cost Office Adjustment A/c.	Dr.	1	1200	
To Cash				1200
Being wages paid.				

Disbursements.—This term has been used in a comprehensive fashion to include invoices for direct charges to jobs, and transactions passing through the Transfer Journal and General Payments Journal. As far as the invoices are concerned, these are posted by the Cost Office into an analysed Invoice Journal, from whence they are debited to the various cost accounts. At the end of each month the invoices are passed to the Financial Office with the total attached. They are then entered, in total, into a single column Invoice Journal, and from there posted to the Cost Office Adjustment Account. The General Payments Journal is kept by the Financial Office, and it is quite convenient for the Cost Office to use it as a posting medium. The Transfer Journal, also kept by the Financial Office, deals with many transactions that are not necessarily costing items. In order to separate the relevant items from the irrelevant it is convenient to have two columns in the Journal headed “Cost Office Adjustment Account” and “Cost Office Adjustment Account—Contra Expenditure.” This will be found greatly to facilitate the work of the Cost Office and will ensure that they post only those items applicable to their accounts. The journal entries necessary for disbursement are :

		Journal Entry No. 2.		
<i>Costing Books—</i>			£	£
Disbursements Control A/c.	Dr.	4	600	
To General Ledger Adjustment A/c.		1		600
Being sundry disbursements.				
<i>Financial Books—</i>				
Cost Office Adjustment A/c.	Dr.	1	600	
To sundry persons				600
Being sundry disbursements.				

Materials Purchased.—These are really nothing but disbursements in the eyes of the Financial Office, but as a separate Control Account is necessary for them in the Costing Books, they have been dealt with separately. The invoices will be entered into the stores ledgers *via* a Goods Inwards Journal and then passed on to the Financial Office with the total attached as in the case of ordinary invoices. The following journal entries will be applicable :

	Journal Entry No. 3.
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Treatment of Costing Transactions.—Each week postings are made to the various cost accounts in respect of wages, materials, disbursements, hired haulage, Corporation haulage, plant charges, and oncost. The total of each of these elements of cost is ascertained and utilised to make the following journal entry :

		Journal Entry No. 5.		
			£	£
<i>Costing Books—</i>				
Work in Progress A/c.	<i>Dr.</i>	9	4300	
To Sundries :				
Wages Control A/c.		2		1200
Stores Control A/c.		3		1300
Disbursements Control A/c.		4		600
Hired Haulage Control A/c.		5		400
Corporation Haulage Control A/c.		6		300
Plant Charges Control A/c.		7		50
Oncost Control A/c.		8		450
Being work in progress for week ended.....				

These transactions are recorded by the Cost Office only ; they are purely items of cost and necessitate no corresponding entry in the financial books. Similar postings are made week by week until the quarterly transfers are prepared for the Financial Office. These are journalised in the following manner :

		Journal Entry No. 6.		
			£	£
<i>Costing Books—</i>				
Sundries :	<i>Dr.</i>			
To Work in Progress A/c.		9		4300
General Ledger Adjustment A/c.		1	3500	
Corporation Haulage Control A/c.		6	300	
Plant Charges Control A/c.		7	50	
Oncost Control A/c.		8	450	
Being transfers for quarter ended.....				
<i>Financial Books—</i>				
Sundry Jobs	<i>Dr.</i>		4300	
To Sundries :				
Cost Office Adjustment A/c.		1		3500
Income : Use of Corporation Haulage.		2		300
Use of Plant		2		50
Supervision and Establishment Charges		2		450
Being costing transfers for quarter ended....				

With regard to rechargeable works, such as road reinstatements for the Gas, Water and Electricity Companies, private contractors, etc., the Cost Office enters the amount of the

charge into the Day Book when the account is sent, and the Financial Office posts the Sundry Debtors Ledger in the usual way. At the end of the financial year an analysis of the Day Book under the headings of Adjustment Account, Corporation Haulage, etc., is prepared in order that the necessary entries may be made in the appropriate accounts. For the purpose of this description it has been assumed that this analysis is incorporated in Journal Entry No. 6, above.

To complete the illustration, assume that the value of stores in hand at the commencement of the year was £2400. This would have stood as a debit balance in the Cost Office Adjustment Account and the Stores Control Account, and as a credit balance in the General Ledger Adjustment Account. The ledger accounts incorporating the above transactions would then appear as shown hereunder.

It will be found convenient to have a separate Adjustment Account and a separate set of Control Accounts for each committee. This will necessitate transfers between the various accounts when, for instance, one committee's lorries are used by another committee's works staff.

The system ensures complete and direct interlocking of the accounts, and the following advantages are to be gained from its adoption :

- (1) Automatic reconciliation is ensured.
- (2) The elimination of analysed Invoice Journals in the Financial Office results in the work of that office being relieved during the busy billing period.
- (3) The work of analysis is left entirely in the hands of the costing staff, who are more conversant with the work concerned.
- (4) The costing books are controlled on a double entry basis.

Dr

Cr.

STORES CONTROL ACCOUNT

Account No. 3.

		£			£
To Balance brought forward		2400	By Work in Progress A/c.	5	1300
„ General Ledger Adjustment A/c.	3	1500	„ Balance carried forward		2600
		<u>3900</u>			<u>3900</u>
„ Balance brought forward		<u>£2600</u>			

DISBURSEMENTS CONTROL ACCOUNT

Account No. 4.

		£			£
To General Ledger Adjustment A/c.	2	<u>600</u>	By Work in Progress A/c.	5	<u>600</u>

HIRED HAULAGE CONTROL ACCOUNT

Account No. 5.

		£			£
To General Ledger Adjustment A/c.	4	<u>400</u>	By Work in Progress A/c.	5	<u>400</u>

CORPORATION HAULAGE CONTROL ACCOUNT

Account No. 6.

		£			£
To Work in Progress A/c.	6	<u>300</u>	By Work in Progress A/c.	5	<u>300</u>

PLANT CHARGES CONTROL ACCOUNT

Account No. 7.

		£			£
To Work in Progress A/c.	6	<u>50</u>	By Work in Progress A/c.	5	<u>50</u>

ONCOST CONTROL ACCOUNT

Account No. 8.

		£			£
To Work in Progress A/c.	6	<u>450</u>	By Work in Progress A/c.	5	<u>450</u>

WORK IN PROGRESS ACCOUNT

Account No. 9.

		£			£
To Sundries	5	<u>4300</u>	By Sundries	6	<u>4300</u>

Financial Books.

COST OFFICE ADJUSTMENT ACCOUNT

Account No. 1.

		£			£
To Balance brought forward		2400	By Sundries	6	3500
„ Wages paid	1	1200	„ Balance carried forward		2600
„ Disbursements	2	600			
„ „	3	1500			
„ „	4	400			
		<u>6100</u>			<u>6100</u>
„ Balance brought forward		<u>£2600</u>			

GENERAL LEDGER—INCOME

Account No. 2.

Fo.	Use of Corporation Vehicles.	Fo.	Use of Plant.	Fo.	Supervision and Establishment Charges.
6	£300	6	£50	6	£450

Note.—General Ledger Expenditure Accounts, Sundry Debtors, Sundry Creditors, and Cash Account have been omitted from the above.

13. A Costing system is being installed in connection with a Highways Department. Draft instructions to (a) the Storekeeper, (b) General Foreman, (c) the Ganger or Charge-hand, on the way to deal with stores required on a job, and surplus stores returned from a job.—*Institute of Municipal Treasurers and Accountants (Final)*.

14. Using hypothetical figures, draft a monthly cost-sheet for a commercial motor transport vehicle. The sheet should be made up of three sections, viz.: (a) Performance record; (b) Performance averages; (c) Costs for month.—*Institute of Municipal Treasurers and Accountants (Final)*.

15. What do you understand by Unit costing?

How could this system be applied to the following services:—(a) Police; (b) Roads; (c) Hospitals; (d) Sewers; (e) Street Lighting?—*Institute of Municipal Treasurers and Accountants (Final)*.

16. Outline a general scheme of Stock-keeping for a Municipal Body having a number of depot stores within the area, much of the material being necessarily interchangeable. What system of control would you recommend, assuming the area to be a large one?—*Institute of Cost and Works Accountants (Inter.)*.

17. What are the main difficulties of obtaining comparable unit costs for road construction and maintenance.—*Institute of Municipal Treasurers and Accountants (Inter.)*.

18. Describe a system of stores allocation with which you are familiar.—*Institute of Municipal Treasurers and Accountants (Inter.)*.

19. The undermentioned figures have been extracted from the Chesterfield rate return for 1938-39 :

Town.	Rate in £.		Rate per head of population.		
	s.	d.	£	s.	d.
Birmingham . . .	15	6	5	1	10
Blackpool . . .	8	6	5	7	8
Darlington . . .	8	8	2	16	11
Manchester . . .	16	0	6	10	3
Newcastle-upon-Tyne .	10	8	4	10	4

Discuss generally the variation in costs of rate services in these towns and indicate, in your answer, the reasons likely to account for these variations.—*Institute of Municipal Treasurers and Accountants (Final)*.

20. Set out your views on the separation and integration of accountancy and costing records.—*Institute of Municipal Treasurers and Accountants (Final)*.

21. How would you apportion the general administration expenses of a local authority over various services, including trading undertakings and war emergency services.—*Institute of Municipal Treasurers and Accountants (Final)*.

- (2) That Factory Oncost may be taken as 1d. per unit for each process on the total of units delivered.
- (3) That Opening Stock of Process A and stock of raw material received into Process A may be taken at 2s. per unit.
- (4) That Opening Stock of Process B and units received into that Process may be taken at the average cost of units delivered by Process A during the current month, and similarly as regards units received by Process C from Process B.

Prepare Process Cost Sheets accordingly. Calculations need not be carried beyond one decimal place.

[N.B.—The remaining questions in this paper which do not refer to costing are omitted.]

NOVEMBER, 1931

4. ZYX Co., Ltd., manufacture lemon squash.

Prepare from the following balances and records Manufacturing, Trading, and Profit and Loss Accounts, showing in them such percentages and figures per case as will furnish costing information and facilitate periodical comparisons.

	£		£
Stocks at cost, on Jan. 1st, 1931 :		Factory Rent . . .	594
Bottled Lemon Squash	2,112	Carriage Inwards . . .	382
Ingredients . . .	4,784	Distributing Charges . . .	522
Bottles, etc. . .	1,226	Office Salaries and Expenses	2,080
Purchases : . . .		Selling Expenses . . .	904
Ingredients . . .	10,432	Stocks at cost, on June 30th, 1931 :	
Bottles, etc. . .	3,128	Ingredients . . .	3,775
Factory Wages . . .	5,120	Bottles, etc. . .	1,007
Factory Expenses . . .	628	Sales . . .	26,294

The stock of bottled lemon squash on June 30th, 1931, was 12,500 cases; 7,000 cases produced during the period had been invoiced out at £1,824 and treated as sales, but were still held by customers on sale or return on June 30th, 1931.

Messina lemons purchased at 24s. a case during the year 1930 have been found unsuitable for manufacture; the Sales include 1,260 cases of these lemons sold during the period at 18s. a case and 180 cases were still in stock on June 30th, 1931, when the market value was 16s. a case.

100,000 cases of bottled lemon squash were produced during the six months.

7. M, Ltd., have for many years had an average of six motor lorries and have kept a separate Operation and Maintenance Account for each. They ask you to advise them at what average age it is economical to renew.

How will you proceed in order to determine your advice?

MAY, 1932

4. A Company owning its own premises and engaged in the printing trade has, in addition to offices and stock rooms, the following departments: Mechanical Composition, Hand Composition, Letterpress, Binders. The motive power is steam, and exhaust steam is used for heating.

Supplying your own data, give the form of the statement which would be prepared to show the cost of the Power and Heating Department and the allocation thereof to the other departments. Indicate the basis of distribution.

machine should be installed to produce articles at present being assembled on relatively inexpensive equipment by oxy-acetylene gas welding.

The facts relating to the present gas welding method are :

Two skilled welders working together on a jig, the total works cost of which is £100, produce one article every twenty minutes, and at that speed of working earn 3s. an hour each.

Overheads average 75 per cent. on Productive Labour made up as follows :

10 per cent. for indirect expenses which vary directly with Productive Labour.

65 per cent. for other Works and Administration Charges.

75 per cent.

The programme is 800 articles a week, consequently 6 jigs, working day shift only, are used.

Designs are changed completely from time to time; each change involves making new jigs. Production runs of each design have in the past averaged 40,000, but an unsuccessful design may have to be changed after 10,000.

The estimates relating to the electric flash welding machine, working day shift only, are :

Machine cost including installation £5,000; its useful life can be taken as ten years.

Two semi-skilled operators with an electrician in permanent attendance will produce one article every three minutes, at which speed the operators and the electrician will earn an average of 2s. 6d. an hour each.

The works cost of a set of special electrodes—which are essential for each new design—is estimated at £1,500.

The cost of the electric current that would be consumed is estimated to equal that of the oxy-acetylene gas at present used.

The management ask you as Accountant of the Company :

- (a) to prepare a statement showing in relation to (i) normal runs and (ii) short runs, the costs of production in pence per unit by gas welding compared with the proposed electric flash welding, and
- (b) to give them your general guidance on this matter by way of notes accompanying your comparative cost statement.

THE SOCIETY OF INCORPORATED ACCOUNTANTS AND AUDITORS

INTERMEDIATE EXAMINATION. MAY, 1932

COST ACCOUNTS

1. Costing systems are classified according to the requirements they are designed to meet. Enumerate them, and give one example of a business to which each is applicable.

2. Outline a system of costing you would recommend for a factory producing wireless parts and sets, bearing in mind the fact that large numbers of parts are produced, most of them of small value. What principle would govern your recommendations?

you carry the full estimated profits on such work to the Profit and Loss Account?

7. Draw up a system of cost accounts for a house builder, indicating the manner in which the cost accounts would be co-ordinated with the financial books of the business.

8. Show the following figures graphically by diagram :

Year.	Sales. £	Labour and Materials. £	Selling and General Expenses. £	Profit. £
1928	20,000	16,000	2,000	2,000
1929	25,000	20,300	2,300	2,400
1930	24,000	19,500	2,200	2,300
1931	22,000	18,000	2,100	1,900

INTERMEDIATE EXAMINATION

November, 1935

Time allowed—1 hour

III.—COST ACCOUNTS

1. How would you arrive at the amount to be charged against a particular job for Depreciation of Plant and Machinery in a Factory where the rate of depreciation varied on the different items and machines?

2. Where a business owns the Freehold of the premises, what would be a proper charge in lieu of rent, and what entries would be necessary in relation thereto in a double-entry costing system?

3. Enumerate the books and documents which would be required for a complete costing system, adding explanatory notes where necessary.

4. The following figures show the Actual or Estimated Expenditure for one week in a Laundry. You are required to prepare a Weekly Trading Return and Statement of Costs.

Working Costs :	£
Productive and Stoker's Wages	375
Materials	48
Fuel	45
Lighting, Power, and Water	65
Allowances	10
Upkeep Costs (including Rent, Insurance, Repairs, Depreciation, and Engineers' Wages)	84
Collection and Delivery Costs (including all transport charges, motor upkeep and depreciation, baskets, etc.)	280
General Costs :	
Office Salaries	58
General Expenses	43
Management Salaries	35

Two services are maintained, viz. : (a) Fully Finished; (b) Machine Finished. For the purpose of this question apportion all expenditure as to two-thirds to (a) and one-third to (b). The value of the work done for the week was (a) £758 5s., (b) £346 10s.

FINAL EXAMINATION

*April and May, 1935**Time allowed—1½ hours*

III.—COST ACCOUNTS

FIVE questions only to be attempted, of which question SIX must be one.

1. Give an illustration of a Cost Sheet for (a) a Power Station, or (b) a Gas Undertaking, or (c) a Railway.

2. How far and in what particular manner has mass production affected costs of production?

3. You are requested to draft with appropriate rulings a Time or Job Card suitable for a system where piece work is operated.

4. From the information given below prepare a monthly Cost Sheet of Bricks made, showing cost and profit per 1,000 bricks :

Material—Coal	1,790 tons at 30s. per ton.
Royalty	1s. 6d. per 1,000 bricks.
Stores	£1,665
Labour—Brickmaking	£4,000
Indirect	£1,000
Overcost—Works	25 per cent. of direct charges.
Office	10 per cent. of works total costs.
<hr/>	
Sales	7,000,000 at 55s.
Stock of finished bricks :	
1st of the month	200,000
31st „ „	600,000

COAL PRODUCTION ACCOUNT

Colliery :	A.			B.			C.		
	Cost per ton produced.		Amount.	Cost per ton produced.		Amount.	Cost per ton produced.		Amount.
	s.	d.	£			£			£
Stock . . .	—		8,750	—		10,000	—		11,500
Wages . . .	23	3-64	17,478	—		18,500	—		19,000
Repairs and Re- newals . . .	1	1-14	822	—		925	—		1,600
Stable Expenses . . .	0	3-37	210	—		250	—		90
Rents, Rates, and Taxes . . .	0	8-69	543	—		400	—		470
Royalties . . .	0	8-70	542	—		450	—		500
Depreciation . . .	0	4-41	275	—		300	—		500
Office Expenses . . .	1	0-00	751	—		750	—		1,000
	27	5-95	29,371			31,575			34,660
Profit . . .			13,379			17,425			21,340
			42,750			49,000			56,000
Sales . . .			40,000			44,000			50,000
Stock . . .			2,750			5,000			6,000
			42,750			49,000			56,000

	A.		B.		C.	
Production . . .	15,000	tons.	18,000	tons.	20,000	tons.
Sales . . .	20,000	"	22,000	"	25,000	"
Stock at start . . .	7,000	"	8,000	"	9,000	"
„ end . . .	2,000	"	4,000	"	4,000	"

INTERMEDIATE EXAMINATION. DECEMBER, 1945

1. A timber merchant who anticipates having considerable stocks of timber in process of seasoning, which takes several years, asks his auditor's assistance as to :

- (a) the basis of valuation of these stocks at each annual stocktaking ;
- (b) how the various expenses incurred during the process should be treated in costing the timber for sale.

State your views as to what the auditor's recommendations should be.

2. Set out the various risks which may be covered by insurance in any business with which you are familiar and state in each case how the insurance premium should be treated in the Costing Accounts. What would be the effect on the Costing Accounts if the risks were not covered at all ?

3. What do you understand by budgetary control ?

4. The obvious purpose of a costing system is to ascertain cost. What other advantages may be obtained from a good system ?

5. An Engineering Company has an elaborate costing system and the Cost Office produces monthly statements for the Board. It is found that there is a considerable difference between the result of working as disclosed by these monthly statements and as disclosed by the annual financial statements of the Company. The auditor is instructed to examine the costing system and report on the cause of the difference with recommendations.

3. In a certain machine shop there are five heavy machines, their capital cost and average number of working hours per week being as follows :

5. The following are the Cost Ledger balances as at January 1st, 1945 :

The operations during 1945 were :

Write up the Cost Books (in summarised form) and prepare a Profit and Loss Account.

some materials used in processes, parts required by the Maintenance staff, and consumable stores. Describe a material control system suitable for these circumstances.

3. It has been decided to build a store for packing materials. The total number of items to be carried in the store will be approximately 4,000. You are asked to design the records and clerical procedure to control the balances kept in stock. State :

- What records you would introduce in the stores and the source of the entries to be made therein.
- What records you would introduce in the Cost Office and the source of the entries to be made therein.
- What method of stocktaking you would employ.

4. Goods purchased have to satisfy one or more requirements affecting :

- Chemical contents.
- Physical strength.
- Dimensions.
- Appearance.

Explain a system to ensure that such requirements are met before payment of the supplier's accounts.

5. Describe two methods by either of which you would be fully satisfied that special purchases of materials are absorbed on the jobs for which they are bought.

6. In the re-planning of a factory a new tool-room is contemplated, and it is desired to incorporate a Sub-store. How should this Sub-store be organised in relation to the Main Stores?

7. Outline the general duties of a Storekeeper, and show how he can best contribute to the general efficiency of a factory.

COSTING. Part III.—General Expenses

Questions numbered 1, 2, 3 and 4 are compulsory. Candidates should attempt two only out of the remaining questions numbered 5, 6 and 7.

1. Moulds are placed in a steam container for a manufacturing process and given varying lengths of treatment. Results for a period are as follows :

A.	B.	C.	D.	E.
Product.	Output.	Moulds container will hold.	Times for treatment, hours.	Cost each, pence.
A	300	30	2.40	
B	63	21	1.47	
C	108	36	2.16	
D	400	25	1.25	
E	200	40	1.60	
F	240	60	1.80	
G	150	50	1.00	

The cost of Direct Labour and Overheads was £30 9s. 1d. (7,309 pence). Complete column E and describe your method.

2. There are cases when, as total departmental expenses increase, unit costs per product decrease, and *vice versa*. Describe the circumstances which could cause such results, and give the contents of the form in which they would be disclosed.

3. Draft a statement of the Costs of a Sales Depot, and state how the various items of expense would be controlled.

3. What precautionary measures should be adopted in a works wages system to prevent payment of wages :

- (a) To a person who was absent a whole week, or to a fictitious person.
- (b) To a wrong person.
- (c) In excess of hours worked or work done.

4. Detail methods to effect the payment of wages to a large number of workers in the very short interval between leaving their work and catching a special train.

5. A retail shop decides to pay its assistants a bonus on sales. Certain goods will carry a bonus of 9d. in the £; others will carry a bonus of 6d. in the £; and the rest 3d. in the £. Outline a system of recording to give effect to this.

6. How would you measure "employee performance" of the following grades of labour :

- (a) Warehouse packers.
- (b) Stores labour.
- (c) Internal transport personnel?

7. Outline an incentive scheme suitable for indirect labour. How would a shop foreman control this labour in proportion to changes in production volume?

COSTING. PART II.—Materials

1. A company manufactures highly specialised products. Production is by batches and it is necessary to be able to trace any material used in a batch to the original supplier.

What method would you employ to enable this to be done?

2. How would you distinguish between direct and indirect materials? How would an error in differentiation affect the cost of an article mass produced with other articles in the same factory?

3. A company is considering the following two alternative methods of material control for finished parts :

- (a) Maximum and minimum limits with a re-order level. Stocks to be issued for assembly into assembled units as required.
- (b) Batch control with production initiated in weekly programmes for completion as finished stock several weeks hence for immediate use in assembled units.

State the advantages and disadvantages of each method.

4. A large combine places all orders by a Central-Buying Department. Goods are delivered to the individual factories. Invoices are also sent to the factories, where they are checked and passed for payment to the Central Office.

Outline a system for checking the invoices at a branch factory, and the accounting records which should be maintained at this branch.

5. There is a main store and two auxiliary stores, both being under control of the head storekeeper. One of the subsidiary stores deals with all foundry material, the other being concerned with the smith's shop. For staff economy reasons, it is desired that the minimum amount of recording should be done.

How would you recommend records to be kept and controlled?

6. What method would you adopt to determine the amount of obsolescence applicable to the general stores of a factory? Would you depreciate the values of individual items which are retained for possible future use or would you prefer still to carry them at full purchase price and create a general reserve for obsolescence of stores? Give reasons for your answer.

- (d) Output of commodities varying considerably in texture and type.
3. Prepare a comparative statement of costs, showing the actual with the pre-determined standard, with fullest possible explanations of the variations. State the steps to be taken as the result of the differences discovered.
4. A company has 50 retail shops which are supplied from a Central Warehouse. You are asked to advise on the method of Stock Control and Profit Ascertainment for each shop.
What would you recommend?
5. In an industry with which you are familiar, set out a form of total cost, with such explanatory notes as you consider would assist in its understanding.
6. Would you treat overtime pay as a part of Wages or as an Overhead? Give your reasons.

FINAL EXAMINATION. JUNE, 1944

COSTING. PART I.—(General Arrangement and Assembly)

Questions numbered 1, 2, 3 and 4 are compulsory. Candidates should attempt one only out of the remaining questions numbered 5 and 6.

1. By what methods should Standard Costs be prepared, and what use would be made of budgets for this purpose?

2. Discuss the main features which determine the final form of a complete cost assembly.

Describe how :

(a) The business policy may affect the method adopted.

(b) Policy is influenced by an efficient method of cost presentation.

3. A Works has :

(a) a Management Lunch Room ;

(b) a Staff Lunch Room ;

(c) a Workman's Canteen ;

all supplied from one central kitchen. Separate accounts are required for each as a check on the different prices charged. Suggest and detail a method of accomplishing this result.

4. Assembled units are comprised of components which are manufactured separately, also of paper components which are made by the use of several types of machine. Describe a method suitable for ascertaining the cost of each component and each assembly.

5. For a group of associated companies, detailed information is required about the grades of labour and the rates of pay and bonuses at each factory. Suggest the form in which this information should be given.

6. Discuss the arrangements which would be necessary to cost the wastage of material in a factory producing clothing partly on Government contract and partly for private trade. Cloth for Government work is a free issue, based on a standard quantity specification per article, but any further wastage is on Company account.

COSTING. Part II.—(Overhead Expenses)

Questions numbered 1, 2, 3 and 4 are compulsory. Candidates should attempt one only out of the remaining questions numbered 5 and 6.

1. Recovery rates for overheads are fixed at the beginning of the financial year. At the end of the year it is found that overheads have

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been under-absorbed to the extent of £15,000. This is due to products carrying a low rate of overhead having increased relatively to other products. Give your comments and recommendations.

2. The manufacture of a standard product necessitates an initial expenditure of large amounts for jigs, tools, gauges, etc. Owing to unexpected changes in design, additional expense in tool equipment is incurred. Discuss the effect on production costs, and state how you would recover the equipment expense.

3. What considerations govern management in the fixing of selling prices when business is difficult to obtain and competition is keen? Discuss the statistics and graphs which you would prepare for the guidance of management at such a time.

4. Discuss control accounts and their uses, with particular reference to the methods of reconciliation with the financial accounts.

5. A lorry acquired when new is sold after five years' service. The cost was written off during the first four years in four equal instalments; the fifth year's operating costs included no charge for depreciation. Give your opinion of this basis and describe any alternative you would prefer.

6. With examples, show how the measurement of production efficiency can be obscured by inappropriate methods of Overhead Expense allocation.

FINAL EXAMINATION. DECEMBER, 1944

COSTING. PART I.—General Arrangement and Assembly

Questions numbered 1, 2, 3 and 4 are compulsory. Candidates should attempt one only out of the remaining questions numbered 5 and 6.

1. For a company making many different components with several operations on each, show the methods whereby you would apply the effects of a general increase in direct and indirect wages.

2. To what extent do you consider costs can be an aid to estimating? Select your own industry and illustrate the form in which costs to be used for this purpose should be set out.

3. With regard to Production Costs, the Directors wish to know :

- (a) The Profit earned if :
 - (1) Sold to Wholesalers at 15 per cent. Discount.
 - (2) Sold direct to the Retail Trade.
- (b) The total cost including all Overheads.
- (c) The cost excluding fixed charges.
- (d) The prime cost of each product.

Select any industry you know and prepare a detailed cost statement to show the above information.

4. The following errors have occurred over a period in job costs after various methods of verification have been applied :

- (a) Direct Labour Hours understated.
- (b) Hours classified as Direct in a cost but Indirect in the analysis of wages.
- (c) Wrong Hourly Rates used.
- (d) Irrelevant operations included.
- (e) Component omitted from Material list.
- (f) Wrong Overhead rate used.

State what methods you would subsequently adopt in the cost accounting routine to throw up such errors in the future.

5. Articles of all shapes and sizes are placed as available on a moving belt passing through a kiln for heat treatment. On what basis would you apply the cost of running the kiln to each article?

6. Set out a form of cost statement for an iron foundry turning out large castings of a fairly uniform character. Assume that the labour cost can be charged to each casting but that the quality of iron varies considerably.

COSTING. PART II.—Overhead Expenses

Questions numbered 1, 2, 3 and 4 are compulsory. Candidates should attempt one only out of the remaining questions numbered 5 and 6.

1. A company manufacturing 100 products has a turnover of £500,000 per annum. The company is only working to 75 per cent. capacity and it has been decided to put two new products on the market. The turnover to be expected from these products is £100,000, of which the Direct Material and Labour Costs will amount to 60 per cent. The present Direct Material and Labour Costs are 50 per cent. of turnover, and the net profit is 10 per cent. to turnover.

Using hypothetical figures, prepare comparative Cost Statements to show the probable effect on Profits of introducing the new lines.

2. Discuss the respective merits and demerits of applying Overheads by means of :

- (a) A percentage addition.
- (b) The Machine Hourly Rate.
- (c) The Productive Hourly Rate.

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3. In a shop where the only practicable method of applying Overheads is by means of a percentage on labour, it is found that the same job may be done by workers paid at very different rates. Comment on this and suggest a method to overcome the difficulty without the introduction of an Hourly Rate.

4. To what extent and with what object would you give statistical information as to Overheads to Works Managers and Foremen?

5. Select a method of recording Overheads by means of punched cards and describe its operation. Discuss what you consider to be the advantages and disadvantages of its adoption.

6. Describe the special treatment given to Overheads in marginal costs.

COSTING. PART III.—General Principles and Methods

Questions numbered 1, 2, 3 and 4 are compulsory. Candidates should attempt two only out of the remaining questions numbered 5, 6 and 7.

1. Describe how a method of standard costs is operated, showing what additional internal arrangements are necessary for its working successfully. To which classes of manufacture is it best suited?

2. State in general terms how arrangements are made for the agreement of cost and financial accounts. What are the difficulties usually encountered, how are they overcome and by what means are annual differences adjusted?

3. What is meant by Cost Control? Outline how it is operated with regard to Labour, Material, and Overheads.

4. For a large, well-organised works prepare a table indicating the relation-ship between the Cost Department and the other Departments, stating in each case what matters are concerned.

5. A Company has several Trading Departments and its products are sold to six different classes of trade. The Directors wish to know the profit on each Trading Department and the proportion of profit earned in each class.

	£
Total Wages	7,568
Manufacturing Oncost	12,498
Materials	30,928
Establishment Charges	5,098
Profit	5,608
	<hr/>
	£61,700

The contract involved various processes of manufacture, and the departmental figures relating to these processes for the period during which the contract was executed were :

	Direct Wages.	Overheads.
	£	£
Machine Shop 1	26,784	21,427
Machine Shop 2	31,219	78,047
Assembling Shop	10,460	5,230

An investigation into the figures of the contract showed that the total wages were made up of :

	£
Machine Shop 1	3,054
Machine Shop 2	2,630
Assembling Shop	1,884

If you were investigating the cost of this contract, would you modify the contractor's figures. If so, why? Give actual workings.

2. The following figures relate to a department of a manufacturing business during the five years ended December, 1941 :

	£	£	£	£	£
Direct Wages	29,562	35,280	43,680	47,382	37,484
Oncost—					
Floating	22,812	26,500	30,724	32,496	26,080
Fixed	16,804	16,522	16,680	16,330	16,750

The third year may be regarded as an average year and suitable as a standard measure of activity.

- (1) Calculate an appropriate rate of standard oncost based upon direct wages expenditure (to the nearest 5 per cent.).
- (2) Show what loss (if any) through unrecovered oncost was suffered in the fifth year.
- (3) State what provision the standard oncost made in the first year towards the fixed oncost.
- (4) Why can the third year be regarded as an average year?
- (5) What kind of year would you judge the first year to have been from the point of view of :
 - (a) Profit making.
 - (b) Volume of output.

3. The following are common methods of valuing finished or partly-finished manufactured goods at stock-taking by manufacturers :

- (1) The material and labour cost only.
- (2) The same, plus manufacturing oncost including fixed oncost.
- (3) The same, excluding fixed oncost.
- (4) Material, labour, manufacturing oncost, and establishment charges covering selling and general administration.

(b) Factored goods are sold at $33\frac{1}{3}$ per cent. oncost. To ascertain whether this part of the business is profitable, what information would you require which is not disclosed in the accounts?

6. The profits of a manufacturing business, before making provision for taxation, showed an average rate of 5 per cent. on the total sales. It was the general practice in making estimates to allow for 10 per cent. profit, and the management was concerned to know the main reasons for failing to realise this rate. Departmental rates of oncost had always been used, and a separate provision made for Selling, Delivery, and General Administration expense. State very briefly in what directions the causes of such disparity might be found.

FINAL EXAMINATION, JUNE, 1945

SECTION 1

COST ACCOUNTS AND SYSTEMS OF COSTING

Time allowed—1½ hours

(Brevity and arrangement will be taken into account in marking.)

1. Define :

- (a) Production Order and Component Production Order.
- (b) Machine Oncost.
- (c) Machine Rate.
- (d) Departmental Oncost.

2. In all manufacturing businesses purchases in bulk are made, the consumption of which is subject to Stores control. Describe very briefly the accounting methods which are necessary to ensure :

- (a) That all consumption of materials and other purchases which form part of the manufactured goods produced is charged to the appropriate works orders which authorise the production.
- (b) That other kinds of consumption, such as lubricating oil for the producing machines, are included in the statements of manufacturing oncost which are prepared from time to time.

In answering this question, commence with the purchase records and end with the completed statement of cost, but do not discuss the varying bases as to price for charging out such materials.

3. Selling, Delivery, and General Administration Expense (or "Establishment Charges") are usually provided for in costs by adding a percentage to total manufacturing cost sufficient to cover such. What is the principle underlying this method?

The Ministry of Supply and other Government Departments have not followed this normal rule but have generally reimbursed all oncost, whether manufacturing or otherwise, on the basis of the ratio of such oncost with the direct wages expenditure. Bearing in mind that manufacturers during the present war have often been supplied with material free of charge and therefore have had no need to purchase such, do you see any reason for this departure from the normal commercial practice described above?

4. For the purpose of comparing the costs of the same article produced by two different manufacturing organisations, how would you set out and what detail would you show as regards :

- (1) The Direct Wages Cost.
- (2) The Manufacturing Oncost.
- (3) Material Cost.
- (4) Establishment Charges?

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Illustrate your answer to the whole of this question by preparing a hypothetical cost and deal with it in the following circumstances, viz.:

- (1) One of these concerns is a Limited Company. The other is a Private Partnership. Managing Directors' salaries and Directors' fees are paid by the Limited Company, but in the Partnership Accounts there is no provision for Partners' remuneration.
- (2) Part of the capital of the Company consisted of debentures bearing interest at 5 per cent. The Partnership had a bank overdraft on which interest was paid.
- (3) The article produced has passed through the processes of machining and fitting, and parts of the article were enamelled.
- (4) In both cases the costs of raw materials and factored parts were identical, but in one case there was received a 5 per cent. discount for payment in seven days, while in the other payment was made monthly and 2½ per cent. discount allowed.

5. A manufacturer wishes to tender for a Government contract for execution in 1945 in circumstances of very keen competition. He estimates that the factory cost of executing the contract would be £31,642 and is satisfied that his competitors could not improve upon this. He was doubtful, however, as to what he should add for general establishment charges, and submitted to you the following schedule of these, viz.:

	£
Provincial Travellers' Salaries	6,422
Provincial Travellers' Commission	7,268
Provincial Travellers' Expenses	3,119
Office Rent and Rates	2,564
Directors' Remuneration	10,000
Office Salaries—London	£2,542
Head Office	7,818

6. The Beattall Iron Foundry expenditure in 1946 was :

	£
Pig Iron	31,580
Coke	3,568
Limestone and Gannister	620
Haulage Chargeable to Cupolas	1,160
Wages of Cupola Men	3,020
Cupola Overheads	3,076
Wages of Moulders	71,364
Wages of Coremakers	8,550
Wages of Patternmakers	3,658
Foundry Overheads :-	
Pattern Shop	1,850
Moulding	65,388
Coremaking	5,658
	<hr/>
	£199,492
Other Foundry Expenditure :	
Dressing	18,252
Sandblasting	6,748
Annealing	12,378
	<hr/>
	£236,870

	Tons.
Weight of Good Castings Moulded	9,052
Weight of Good Castings Dressed	9,052
Weight of Good Castings Sandblasted	3,360
Weight of Good Castings Annealed	2,084

Calculate to the nearest 1d. per ton :

- The cost of melted metal per ton of good castings.
- The dressing, sandblasting, and annealing costs per ton of good castings (each process cost separately).
- The cost of a casting weighing 1 cwt. The moulding wages were £2 6s. 8d. and coremaking wages £1 13s. 6d. A new pattern was not required. The casting, in addition to dressing, was annealed but not sandblasted. The castings produced at this foundry varied in intricacy and the weight basis for ascertaining moulding and coremaking costs would be unsuitable.

FINAL EXAMINATION, DECEMBER, 1945

SECTION I

COST ACCOUNTS AND SYSTEMS OF COSTING

Time allowed—1½ hours

(Brevity and arrangement will be taken into account in marking.)

1. Define the terms :

- Direct Wages.
- Ton-mile.
- Machine-hour.
- Oncost.

2. In a brewery, the unit of output usually adopted is the barrel, and all costs of production are computed in relation to the barrel. Name

	£		£
To Stocks on Hand . . .	43,519	By Sales	213,664
„ Purchases—		„ Stocks on Hand . . .	51,729
Direct Materials . . .	60,000	„ Discounts Received . .	2,481
Indirect Materials . .	7,429	„ Income from Invest-	
Factored Goods . . .	9,242	ments	8,249
„ Wages—			
Direct	49,754		
Indirect	10,428		
„ Fuel and Power	7,829		
„ Tools	3,284		
„ Wages and Salaries other			
than manufacturing . .	12,640		
„ Rent and Rates of Fac-			
tory	7,460		
„ Insurance of Factory and			
Equipment	178		
„ Packing Materials . . .	3,229		
„ Printing and Stationery—			
Factory	1,126		
Office	578		
„ Advertising	3,278		
„ Light, Heat, and Water .	346		
„ Travelling	629		
„ Incidentals	842		
„ Carriage and Freight			
Outward	2,762		
„ Repairs and Mainten-			
ance—			
Factory	1,572		
Office	638		
„ London Office Expenses .	646		
„ Telephone and Telegrams .	378		
„ Directors' Remuneration .	2,000		
„ State and Employer's			
Liability Insurance . .	125		
„ Subscriptions and Dona-			
tions	78		
„ Depreciation—			
Plant and Machinery . .	1,298		
Office Furniture and			
Fittings	176		
„ Legal and Accountancy			
Charges	362		
„ Bank Charges	326		
„ Bank Interest	1,152		
„ Bad Debts	729		
„ Mortgage Interest . . .	1,000		
„ Income Tax—			
Schedule A	242		
Schedule D	5,894		
„ Discounts and Allow-			
ances	2,246		
„ Profits	32,708		
	<u>£276,123</u>		<u>£276,123</u>

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The Stock on Hand consisted of :

	Commencing.	Ending.
	£	£
Raw Materials	8,524	13,262
Factored Goods	4,428	5,084
Work in Progress	16,825	19,428
Completely Manufactured Goods	13,742	13,955
	<u>£43,519</u>	<u>£51,729</u>

No indirect materials were brought into stock at the beginning or end.

(1) Prepare statements from this account showing :

Manufacturing Wages	£
Manufacturing Oncost	
Materials Consumed in Manufacture	
Total Manufacturing Cost	
Selling, Delivery, and General Administration Expense	
Total	

- (2) Give briefly your reasons for omitting from the above-mentioned statement any expenditure shown in the Trading and Profit and Loss Account, if you consider they should be excluded.
- (3) Calculate, to the nearest 5 per cent., the ratio of Manufacturing Oncost to Manufacturing Wages, and the ratio of Selling, Delivery, and General Administration Expense to total Manufacturing Cost.

6. The direct wages and oncost expense for each quarter of 1911 were :

1	2	3	4
£	£	£	£
10,000	15,000	18,000	22,500
	16,000	16,000	18,000

2. A new engineering shop has been equipped at a cost of £10,000, as an addition to existing works buildings.

Write a note for the Directors' information explaining your views as to the costing of the output of this shop. Deal with the calculation of machine rates and their application, and explain what charges should be included in the costs in respect of (1) cost of operating the plant; (2) depreciation of the plant; (3) interest on the capital invested in the plant. Outline the methods by which the information needed would be obtained.

3. A colliery produced 15,000 tons of saleable coal during last month. From the following particulars prepare a Cost Sheet for the monthly meeting of the Board; you may supply any additional figures you need for comparative purposes and add any remarks or explanations which you think will be useful to the Board.

	£	s.	d.
Wages, Underground	7,500	0	0
Pitwood	1,312	10	0
Stores, Underground	750	0	0
" Surface	937	10	0
Railway Charges	2,812	10	0
Truck Hire	562	10	0
Rates	125	0	0
Horse-keep	625	0	0
Surface Wages	3,750	0	0
Repairs and Renewals	437	10	0
Depreciation	93	15	0
Office and General Expenses	156	5	0
Insurances	281	5	0
Royalties	250	0	0

4. A multiple shop company, having 150 establishments, deals with four main commodities and "Sundries." All purchases are made by the Head Office, which charges goods out to branches at selling prices. All sales are for cash.

The management desire to keep a close supervision of:

- (1) The stocks held at each of the shops;
- (2) The relative selling costs of each shop.

You are required to outline your suggestions, indicating the returns which you consider each manager should make to the Head Office, and stating what use should be made by the Head Office of these returns.

5. Explain the methods adopted for the calculation and payment of wages on:

- (1) Day-rates.
- (2) Piece-rates.
- (3) Any Premium bonus system with which you are familiar.

Describe briefly a system of wage record with which, as a cost accountant, you would be satisfied, and indicate the variations which would be necessary to adapt the system to one of the other methods of payment.

6. Describe the practice adopted in making up the Balance Sheet of any business with the operations of which you are familiar, in regard to the valuation of:

- (1) Unfinished goods in course of manufacture for stock, and
- (2) Contract work in progress;

and express your views upon the methods you describe.

STAGE III.—ADVANCED—March, 1932

COSTING

3 hours allowed

(First and Second-class Certificates will be granted in this Stage.)

1. Define the following terms :

- (1) A capital service.
- (2) Works cost.
- (3) Control account.

2. Where standing expense orders are in use for collecting oncost expenditure, how would you arrange to ascertain the cost of specific services, *e.g.* cost of maintenance of a particular machine or the cost of a particular experiment ?

3. Draw up a skeleton statement of a wages (pay-roll) analysis for a works which comprises several departments. At what periods would you propose that it should be rendered ? To what members of the works organisation would you suggest that it should be issued ?

4. What is meant by uniform costing ? What advantages would you consider to accrue from its adoption in an industry ?

5. In the course of compiling machine-hour rates of absorption of Oncost the various expenses have been allocated to the different machines or groups of machines. In order to determine the hourly rates of a particular machine or group of machines, would you take as the divisor, into the total expenses so allocated, the maximum hours on a one-shift basis or some other figure ? Give your reasons and indicate what effect your decision may have on the amount to be included in respect of certain of the expenses.

6. Express graphically on the squared paper provided the following information. What deductions would you expect the works manager to make from it and what further information would he probably call for in this connection ?

Period.	Produced.	£	s.	d.	£	s.	d.
Jan. to March . . .	400	4200	0	0	10	10	0
April	200	1900	0	0	9	10	0
May	250	2062	10	0	8	5	0
June	250	2000	0	0	8	0	0
July	200	1700	0	0	8	10	0
August	200	1700	0	0	8	10	0
September	300	2400	0	0	8	0	0
Oct. to Dec. . . .	500	5000	0	0	10	0	0

7. A road is being constructed which involves the diversion of an hydraulic main at an estimated cost of £150. As an alternative to this diversion a new main of an improved type can be laid down at an estimated cost of £300, the old main, which stands in the books at a value of £100, being in this case abandoned. How would you deal as between capital and revenue expenditure (i) with the expenses of diversion if the former course is adopted, and (ii) with the cost of the new main and the residual value of the old main if the latter course is decided upon ?

4. How should the following matters be treated in cost accounts ?
- (a) Special plant purchased for a particular job which has now been completed.
 - (b) Idle time, and time lost owing to a strike.
 - (c) Sick, accident, and holiday pay.
 - (d) The difference between the total value of stores ascertained by a physical inventory and the balance shown on the Stores Control Account.
-

FINAL EXAMINATION (PART II)

November 23rd, 1944

COSTING

Time allowed and instructions as in the paper above.

1. Set out your views on the separation and integration of accountancy and costing records.
 2. There are various types of machines available for costing. Discuss the relative advantages and disadvantages of different types which you know.
 3. What information would you require to be kept of plant and machinery to enable accurate and scientific costs to be obtained ?
 4. How would you apportion the general administration expenses of a local authority over various services, including trading undertakings and war emergency services ?
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BRITISH ASSOCIATION OF ACCOUNTANTS AND AUDITORS

INTERMEDIATE EXAMINATION

May, 1945

COSTING

Time allowed—2 hours

Questions 1, 2 and 3 are compulsory. Candidates should answer THREE ONLY of the remaining questions 4, 5, 6 and 7. Answers should be arranged in numerical order.

1. The advantages of costing to a manufacturer are many. Define "Costing" and briefly state its primary purposes and indicate some of the more important advantages.

2. Enumerate the headings under which expenditure comprised in Total Cost should be analysed in order to show clearly all the elements of cost. Define precisely, but briefly, each of the *Elements of Cost*.

3. Set out in list form the following expenses, and in an adjacent column indicate the basis you would suggest for apportionment to Works, Shops, or Departments; Central heating; Electricity (a) Power, (b) Light; Cost of Timekeepers; Cost of Wages Department; Insurances (a) Buildings, (b) Machinery, (c) Workmen's Compensation, (d) Stores materials; Depreciation. (a) Buildings, (b) Machines; Rent; Welfare Expenses; Sundry works expenses; General Labourers or handymen.

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An alternative to Bin Cards kept with or near each kind of material is a Stores Material Control Record (Fig. 12) written up in the Stores in a loose-leaf book, or card file, in place of Bin Cards. On this record, as on the Bin Cards, quantities only are recorded, all money values being shown only in the Stores Ledger in the Office. An advantage of this record is that the storekeeper has all details close at hand, and can keep noted in

FIG. 13.

STORES LEDGER

Material :				Code :				Maximum :				Folio :			
								Minimum :							
Dr.				RECEIVED.				ISSUED.							
Date.	G.R. No.	Supplier or Remarks.	Quan- tity.	Rate.	£	s.	d.	Date.	Iss. Req. No.	Quan- tity.	Rate.	£	s.	d.	Notes

FIG. 14.

STORES LEDGER (2nd type)

Article :				Code :				Maximum :				Folio :				
								Minimum :								
Date.	G.R. No.	Sup- plier.	Quan- tity re- ceived.	Rate.	£	s.	d.	Date.	Req. No.	Quan- tity issued.	Rate.	£	s.	d.	Balance Quan- tity.	Notes

it such information as quantities ordered, probable requirements for particular contracts, and other details. Where transfers between inter-departmental stores are numerous, an additional section may be included on the Stock Record Sheets for details of the transfers as distinct from issues to the shops.

Stores Ledger.—The Stores Ledger is kept in the Works Accounts Office, and is parallel with the Bin Cards, except that money values are shown. Correct stores accounting is as important as accounting for cash, hence the separation of this clerical work from the actual handling of the materials.

The ruling of the accounts may be as shown in Fig. 13, or follow the Bin Card ruling, with the addition of money columns as in Fig. 14.

In some factories it may be unnecessary to show money values in the Stores Ledger, but this is the exception, not the rule.

An account is opened in the Stores Ledger for every kind of material. A columnar account may be used for different sizes, etc., of one kind.

The debit side is prepared from the invoices and Stores Debit Notes—the credit side either directly from Stores Requisition Notes, or from an abstract summary compiled from them. The Stores Ledger folio should be marked against every item so posted. Tabulating machines are used in large works.

Perpetual Inventory.—This may be defined as a method of recording Store balances after every receipt and issue, to facilitate regular checking and to obviate closing down for stock-taking. It is sometimes termed “Continuous Inventory.”

The Perpetual Inventory System.—The balance of any account in the Stores Ledger should agree with the balance shown on the Bin Card, or Stock Control Record, for the same item of material, and a frequent checking of these dual records should be made, as well as of the actual quantity in stock.

The essential feature of the perpetual inventory system is the continuous checking of the stock. A number of items of material are counted daily or at frequent intervals, and compared with the Bin Cards and Stores Ledger by a Stores Audit Clerk. Discrepancies are inquired into; many may be clerical errors, which are corrected. When, however, the stock is incorrect, an investigation is made, after which any shortage, or surplus, is adjusted in the records to make them correspond with the physical count. This may be done conveniently by making out a Credit Note or Debit Note, as the case may be, for the difference, and, after obtaining authority to pass for adjustment through the Cost Journal, debiting (or crediting) a Stock Adjustment Account. The balance on that account is written off direct to Profit and Loss Account at appropriate times.

The usual causes of differences are: Incorrect entries, breakage, pilferage, evaporation, breaking bulk, short or over issues, absorption of moisture, price approximation or pricing method, and placing of stores in wrong bin.

The method of keeping Stores Accounts described above is known as the Perpetual or Continuous Inventory System. Its valuable advantages are :

(1) The long and costly work of a stocktaking count is avoided, and the stock of materials, as shown by the Stores Ledger (but not the Work in Progress), can be obtained quickly for the preparation of a Profit and Loss Account and Balance Sheet at interim periods if required.

(2) A detailed, reliable check on the stores is obtained.

(3) Discrepancies are readily localised and discovered, giving an opportunity for preventing a recurrence in many cases.

(4) The moral effect on the staff tends to greater care, and serves as a deterrent to dishonesty.

(5) The audit extends to comparing the actual stock with the authorised maxima and minima, thus ensuring that adequate stocks are maintained within the prescribed limits.

(6) The storekeeper's duty of attending to replenishments is facilitated, as he is kept informed of the stock of every kind of material, thus ensuring uninterrupted and safe manufacturing stocks.

(7) The stock being kept within the limits decided upon by the management, the working capital sunk in stores materials cannot exceed the amount arranged for.

(8) The disadvantages of excessive stocks are avoided, as, for instance :

(a) Loss of interest on capital locked up in stock. (b) Loss through deterioration. (c) Danger of depreciation in market values. (d) Risks of obsolescence.

The Pricing of Stores Material Issues.—The method of pricing materials issued largely depends upon the nature of the materials, the undertaking concerned, and the circumstances which require to be taken into consideration.

The purpose of Cost Accounts is to arrive at the actual cost of each job, or of each process or operation of manufacture, and, to this end, it is desirable to charge out stores material at cost.

Some business men prefer that material issued should be charged to Cost Accounts at market prices ruling at the time the materials are used, because these are the prices which would have to be paid if the material were purchased at that time. This procedure introduces considerable confusion into the

accounts, and at once involves departure from the principle of showing actual costs in the Cost Accounts.

There are a few kinds of business, however, where the particular nature of the transactions leads the management to desire that the Cost Accounts should represent the current position, and correspond with estimates, as well as that the efficiency of buying should be revealed, and this information is secured by charging stores at current market prices, regardless whether these are higher or lower than the actual figures paid. When the method is used a careful adjustment in a "Stores Adjustment Account" is necessary.

The result of this procedure is that, in a period of falling prices, the costs of such manufacturers will show as lower than those of manufacturers who charge materials at actual prices paid at an earlier date. This does not mean that the first-named manufacturers are in a more competitive position, for the reason that when submitting estimates, or fixing prices, allowance must be made for the trend of market prices. Herein lies one of the chief points of difference between costs and estimates.

Mention must be made here also of materials which it is necessary to retain for purposes of maturing, of which perhaps the best example is timber. Logs are often sawn longitudinally, and left in this rough state for seasoning, as also is timber cut into suitable sizes. In such cases, the stock appreciates in value, and it is customary to increase the cost by at least the interest on the capital value the stock represents, and other special storage expense may also be added. It is not considered that such an addition for interest to cost is valid. It is probably better to cover the value in the price. There are many kinds of stock held for long periods for reasons other than maturing factors.

Consider whisky and wines which are held for many years. Apart from the storage, insurance, labour, etc., which do add to the cost the selling price needs to cover profit on capital in the form of compound interest for each successive year. Such treatment is better than charging interest in costs, so long as profit for each year's tied-up capital is included in the price.

The method of valuing stores for the Annual Balance Sheet, it is important to observe, is quite independent of the system of pricing for costing purposes. The recognised method of pricing stores for the Balance Sheet compiled from the financial accounts is at cost, or market value, whichever is the lower. The cost

price referred to in this connection is the average cost price of the stores on hand, which, it may be assumed, will consist of the most recent purchases.

The use of the cost price method is a satisfactory one for the Cost Accounts, as it avoids troublesome adjustments.

The Application of the Market Price Method for Stores Issues.

—The materials are priced out at the market price ruling at the time of manufacture. It is usual to ignore small fluctuations, and to prepare a schedule of prices which is used by the Cost Office. As prices rise or fall, the price schedule is amended, thus ensuring revised charging in the Cost Accounts. The fluctuations create a difference on the Stores Account, as a whole, and the book profit or loss due to this cause has to be written off through an adjustment account.

The value of Work in Progress at the date of the Balance Sheet will also require adjustment, as explained in a later paragraph. This method introduces difficult complications, and is not much used.

The Application of the Cost Price Method for Stores Issues.—

The simplest case is where material has been purchased for a specific job, when a direct charge is made at cost to the account for that job. In costing, direct debits should be made whenever possible.

There are several ways of applying the cost price method for materials issued from the stores.

1. *The "First-in—First-out" Method.*—The stores are issued from the earliest lot delivered until exhausted, then from the next delivery—the charge in the accounts being the cost price of each lot. The Stores Ledger clerk can ascertain from the accounts when each consignment is completed. Where market fluctuations are frequent and considerable the method sometimes produces curious and unfair results as between one job and another. Further, if the transactions are numerous the method is unnecessarily involved. It is satisfactory in some cases.

2. *Fixed Prices Method.*—When market prices are fairly stable, with small variations, a fixed price may be adopted, but a price adjustment account is required. It is seldom that this method can be used, except in connection with Standard Costing described in a later chapter.

3. *Use of Average Purchase Prices.*—The average is not that of all of each material bought, but the average of the prices of quantities in stock at the time, and the prices of the quantities

in each new delivery. The price to be charged may be fixed with each new delivery, or, say monthly, if particular conditions permit. The following example will make the method clear :

200 items bought @ 1s.

150 charged out @ 1s.

50 balance @ 1s.

100 New delivery @ 1s. 6d.

150 balance now charged out at 1s. 4d. (the average of 50 @ 1s. and 100 @ 1s. 6d.).

It would be incorrect to charge @ 1s. 2d. (the average of 200 @ 1s. and 100 @ 1s. 6d.).

4. *Last in, First out.*—This method is rarely used, and is not considered desirable in normal circumstances.

Whichever method is used, the cost of Stores used is recovered, and the Stores Ledger can be balanced, both as to quantities and money values, subject to minor adjustments for differences due to wastage, evaporation, and other losses.

Small Parts used in Large Quantities, when of little individual value, are not generally requisitioned and charged separately for each production order. The average quantity used will be predetermined and charged on that basis to each job. A quantity of each of such materials may be issued by the Stores to a Shop and a Shop Stores Account debited at an average cost price. This account will be credited, say weekly, with the estimated quantity for the number of orders dealt with, thereby eliminating much unnecessary detail.

Stores Expenses.—If of a general nature, these are included in Stores Overhead, but expenses particular to a specific order may be charged thereto in addition to the price of the material, as may be the cost of carriage inwards and handling. Sometimes the price at which material is charged out is an inflated one to cover wastage. This is unwise. Such loss can be recovered in cost as a separate charge. This is better also than including wastage cost in stores overhead, as wastage varies according to the type of material. Similar reasoning can be applied against the practise of including in the issue price such items as stores purchasing, receiving and storage, cash discounts, charges for defective work, and credits from disposal

of defective work. It is a common practise, however, to cover these items for convenience by use of a stores overhead expense rate.

The Value of Work in Progress at the date of the Balance Sheet will require adjustment, in the financial accounts, by way of depreciation, if market prices of material have fallen. This applies also to Finished Stock which has been valued at cost of manufacture.

In the event of market prices having risen, however, the stock (whether finished or in progress) should not be written up. An unrealised profit should not be anticipated in the accounts, but an expected loss should be reserved for.

This adjustment is necessary whether the materials are priced out at market price, or at average, or actual cost. The adjustments are more difficult when market prices are used.

Indirect Materials, sometimes called Consumable Stores, such as lubricants, engine waste, and cleaning materials, should be requisitioned in the same way as materials issued for manufacturing operations. The requisitions are summarised and charged to suitable expense accounts, as will be explained in a later chapter devoted to the subject (Chapter IX).

Turnover of Stores Material.—It is an advantage to compare the turnover of different grades and kinds of material as a means of detecting stock which does not move regularly, thus enabling the management to avoid keeping capital locked up in undesirable stocks. It is not an infrequent thing for a particular item of stock to be overlooked for considerable periods, unless means are taken to prevent such accumulations.

Scrap Materials.—(a) In manufacturing operations there are often trimmings, off-cuts, etc., which are waste which has to be collected for sale, destroyed or dumped.

(b) In some cases off-cuts may be suitable for making other things, and this material is returned to store. It is usually taken on charge in the Stores Ledger at a lower value than the original price; a corresponding credit is given to the operation in which it arose.

(c) Other scrap consists of rejected products arising from inspection, or which have been spoiled or damaged and are not capable of being made good. There is often some salvage or sales value.

All saleable or usable scrap should be passed to the care of the storekeeper, so that usual stores records and control can be ensured.

The rate of turnover should be taken for the stock as a whole, of major kinds of material individually. The balance of es, compared with the total withdrawals, indicates how many as a year the stock is renewed.

Small Tools in a general engineering factory form a large valuable stock, consisting as they do of such items as ing tools and bits, milling cutters, reamers, drills, taps, , and many other items of small equipment. Storage, ection and maintenance of such tools involves considerable ense and careful control. This control is effected by the of check discs, foremen's requisitions, or both.

Tool Store procedure is described in Chapter XIV, pp. 206 209.

EXAMINATION QUESTIONS

. It is found that systematic thefts have taken place from the s of a large company manufacturing small machine parts.

beyond the entry of purchase invoices in the bought journal no rds of stores have been kept.

You are desired to recommend an adequate system for the super- n of the stores in future, including the rulings of any books or forms consider necessary. Prepare, therefore, whatever instructions or anations you consider it advisable to issue to the persons who will the future stores records, and append your proposed rulings.— *London Chamber of Commerce*.

1. Describe a system of stock control which retains the advantages physical stock-taking without causing excessive work at the end of accounting period.—*Institute of Cost and Works Accountants (Inter.)*.

2. State the various methods of pricing Stores Requisitions with h you are familiar, and discuss their respective merits.—*Royal ty of Arts (Advanced)*.

3. Select two of the following items and prepare a stock card, with ing prices, showing the rate you would use for each quantity into shop, using your own figures :

- (1) Copper.
- (2) Bolts and Nuts.
- (3) Liquid Paint in tins.
- (4) Steel Bars.
- (5) Flour in sacks.
- (6) Raw Cotton.

Institute of Cost and Works Accountants (Inter.).

4. Draft a form of Bin or Locker Card with three specimen entries eon, and explain the purpose and utility of such cards.—*Society of rporated Accountants and Auditors (Inter.)*.

5. Twenty tons of material are purchased and taken into store, and tually used on six different contracts. State in chronological order records in relation to this material, giving details of all forms which ld be used and all entries in the cost books relating to same.

6. What are the various methods by which stores issues may be ed, and under what circumstances do you consider the practices can aried with advantage? State reasons.—*Institute of Cost and Works untants (Inter.)*.

8. Timber Merchants often have very large stocks of timber in process of seasoning, this process takes several years.

State your views :

- (a) With regard to the valuation of these stocks at each annual stock-taking.
- (b) As to how the various expenses incurred during the process should be treated in costing the timber for sale.

London Chamber of Commerce.

9. Define the following and say on what basis each should be determined :

- (a) Minimum stock.
- (b) Maximum stock.
- (c) Ordering level.

Royal Society of Arts (Advanced).

10. Draw up a specimen bin card for use in a general store and give your reasoned advice as to whether it should be kept in the store office or alongside the goods to which it relates.—*Royal Society of Arts (Advanced).*

11. Copper is purchased at £60 a ton in January for general stock and is used in the following June when the market price has risen to £70 a ton. What figure would you use in your costs? Give reasons for your answer.—*Royal Society of Arts (Advanced).*

12. In Costing, materials may be charged out to jobs at cost price, or at market price. Explain which method is in your view preferable, giving your reasons, and state how, under the respective methods, fluctuations in the Costing Accounts will arise, and under what headings they will appear.—*Institute of Chartered Accountants (Final).*

13. A manufacturing concern purchases from time to time large quantities of a commodity used in the manufacture of one of its products. The following are the details of purchases during the six months ended June 30th, 19... : $\times 3 \text{ K}$ H8 4515

19...	Quantity.	Cost Price per 100.
		<i>s. d.</i>
February 2	10,000	10 0
March 15	25,000	10 6
April 20	20,000	9 6
May 3	15,000	9 0
June 1	12,000	9 0
June 20	3,000	8 6

There were 15,000 units in stock at January 1st, 19..., which were valued at 9s. 6d. per 100.

Quantities issued from store during the six months were as under :

19...	
January 25	10,000
February 28	8,000
March 29	25,000
April 30	20,000
May 15	18,000
June 29	15,000

At what prices should the issues be charged and the closing stock valued? Prepare a Stores Ledger Account illustrating your views.—*The Society of Incorporated Accountants and Auditors (Final).*

14. Distinguish between Stores and Stock. Under what circumstances, if any, would you as an Auditor feel justified in accepting :

figure for Stores or Stock, knowing that an Inventory had not been made at the balancing date?—*The Society of Incorporated Accountants and Auditors (Inter.)*.

15. Departmental Stores situated in a works frequently interchange various materials. Describe an accounting system showing how these transactions should be recorded.—*Institute of Cost and Works Accountants (Inter.)*.

16. What steps would you take to ascertain and to eliminate over-investment of capital in stocks?—*Institute of Cost and Works Accountants (Inter.)*.

17. Give specimen ruling of a stores requisition and describe fully its routine throughout the workshops and cost department.—*Institute of Cost and Works Accountants (Inter.)*.

18. Assume all records of stock are kept in the Cost Office—devise a scheme for checking at irregular periods the actual stock in the store-room.—*Institute of Cost and Works Accountants (Inter.)*.

19. Discuss the respective merits and demerits of keeping store records of quantities :

- (a) Alongside the stocks to which they relate ;
- (b) In cabinets in an office conveniently placed in the storehouse ;
- (c) In the cost office.

Institute of Cost and Works Accountants (Inter.).

20. Describe the arrangements you would make for stocktaking throughout a large works in order that completion may be reached as quickly as possible.—*Institute of Cost and Works Accountants (Inter.)*.

21. Describe with sample card and a few specimen entries, the working of the maximum and minimum method of stock-keeping.—*Institute of Cost and Works Accountants (Inter.)*.

22. In charging out materials to work orders, what alternative methods are available for dealing with the effect of market fluctuations on the values of materials in store?—*Institute of Cost and Works Accountants (Inter.)*.

23. Describe briefly how you would conduct the audit of a system of continuous stocktaking and what procedure you would adopt to deal with differences.—*Institute of Cost and Works Accountants (Inter.)*.

24. Assume that it is the policy of a certain brass foundry to make monthly purchases of copper. The market rates have fallen :

	Per ton.
April 19..	£105
June 19..	20
May 19..	55
September 19..	45

How would you propose to price withdrawals from store for manufacture carried out during the period in question? State on what basis you assume selling prices to be determined.—*Institute of Cost and Works Accountants (Inter.)*.

25. For Balance Sheet purposes it is customary to value stores at cost or market price, whichever is the lower. Would you adopt the same basis in charging out stores for costing purposes? Give reasons for, and explain the effect of, the method you advocate.—*Society of Incorporated Accountants and Auditors (Inter.)*.

26. You are instructed to organise a factory stores, and arrange for maximum and minimum quantities. Discuss the determining factors which would influence your decisions concerning these quantities.—*Institute of Cost and Works Accountants (Inter.)*.